

repairs have been accomplished, to reveal soft areas missed by the initial proof rolling and improper or inadequate repairs. Proof rolling shall be in accordance with TSDHPT specification, Item 216 and shall consist application of one coverage of a heavy pneumatic-tired roller meeting the requirements of Item 216 with exception that the tires shall be inflated to 150 PSI and each tire shall be loaded to a minimum of 9 tons. Proof rolling shall be applied to the surface of the entire base course. Materials in the base course or underlying materials indicated unacceptable by the proof rolling shall be removed and replaced, as directed, to render the base course suitable for the installation of subsequent pavement. After all failed areas, discovered as a result of the initial proof rolling operation, have been repaired, the entire surface of the base course shall be proof rolled again to ensure satisfactory repairs and to reveal any failed areas not discovered by the initial proof rolling operation whereupon these areas may be repaired. Proof rolling shall continue until the entire base course to receive new pavement shows no signs of distress (pumping, rutting, etc.) under the application of the specified proof roller.

13. PREPARATION FOR BASE COURSE REPAIRS: Depending on conditions, failed existing base course, shall be excavated, full depth to the subgrade or scarified and stabilized in place. Depending on the nature of the material, excavated base course shall be wasted or wind-rowed for reinstallation. Excavation of base course shall extend well into sound material to ensure well compacted, stable material for the subsequent paving course. Generally, cement stabilized base course materials cannot be stabilized and must be excavated. Generally, aggregate base courses may be stabilized and reused. If necessary, the exposed subgrade shall be recompacted/repaired as specified in SECTION: EXCAVATION, AND PREPARATION OF SUBGRADE and made ready for base course repairs.

14. REPAIRS TO EXISTING BASE COURSE: Repairs to existing base course, required as a result of proof rolling operations shall be accomplished in one or a combination of several methods as specified or directed.

14.1 The existing base course material, if suitable for reuse, shall be scarified, aerated, or moistened as appropriate and reinstalled in well compacted 6 inch lifts, and brought to grade. Existing base course material shall be supplemented with new graded-crushed-aggregate base course material if necessary to obtain the proper volume of material to meet grade requirements. Fly ash shall be mixed into the existing material in the proportions directed at the request of the Government to aid in the stabilization process. Fly-ash used in this application will be paid for as a separate item as specified in SECTION: ASPHALT PAVEMENT RECYCLING USING CLASS "C" FLY ASH. Application rates are typically approximately 16% by volume or approximately 100 lb/SY/6 inch lift of base material to be stabilized.

14.2 New graded-crushed-aggregate base course material shall be installed in well compacted 6 inch lifts to bring the excavation up to the proper grade.

14.3 Flowable fill as specified in SECTION: CONCRETE, GENERAL REQUIREMENTS shall be installed to bring the excavation up to proper grade.

15. GRADE CHANGES: When grade changes are required or specified, they shall be accomplished by one or a combination of several methods as specified or directed.

15.1 New Grade Below Existing Grade: Existing base course shall be bladed and excavated to proper grade. When excavation will result in existing base course having a deficient thickness, as determined by the Contracting Officer, the existing base course and subgrade shall be excavated. Excavation shall be of the depth necessary to install the required thickness of new graded-crushed-aggregate base course material or reinstall existing base material if judged suitable. If necessary, the existing subgrade shall be repaired/recompacted as specified in SECTION: EXCAVATION, AND PREPARATION OF SUBGRADE and made ready for installation of new graded-crushed-aggregate base course material or reinstallation of existing satisfactory base material. New graded-crushed-aggregate base course material shall be installed in well compacted 6 inch lifts and made ready for the subsequent paving course. Proof rolling of the repaired area shall be accomplished if directed.

15.2 New Grade Above Existing Grade: Depending on the extent of the grade change, existing base course may be brought up to required grade by installation of new graded-crushed-aggregate base course or by the installation of HMAC as specified in SECTION: BITUMINOUS COURSES FOR PAVEMENTS (CENTRAL PLANT HOT-MIX), as directed. When new-graded-crushed aggregate base course material is added to existing base course it shall be placed as specified below. In no case will thin layers of new graded-crushed-aggregate base course material be added to the top layer of existing base course to meet grade. The surface of the existing base course shall be scarified to a depth of at least 3 inches, new graded-crushed-aggregate base course material added, and the layer shall be blended and recompacted to bring the surface to the required grade. If existing base course is cement stabilized or is sandstone and cannot be scarified, new graded-crushed-aggregate base course shall not be placed in layers of less than 3 inches in thickness. In areas where new graded-crushed-aggregate base course will be less than 3 inches in thickness, existing base course shall be excavated as specified above, and new graded-crushed-aggregate base course material installed full depth, or grade change shall be accomplished using HMAC as specified in SECTION: BITUMINOUS COURSES FOR PAVEMENTS (CENTRAL PLANT HOT-MIX), as directed. Generally, if the elevation of top layer of existing base course is slightly below the grade specified, the existing base shall be brought up to grade using HMAC. Generally, if the elevation of the existing base course is significantly below the grade specified, grade changes shall be accomplished using new graded-crushed-aggregate base course material as specified above. The method specified will determined by the Government.

16. PREPARATION OF UNDERLYING COURSE: Prior to constructing or installing new graded-crushed-aggregate base course, the underlying course shall be

cleaned of all foreign substances. At the time of construction of the graded-crushed-aggregate base course, the underlying course shall contain no frozen material. The underlying course shall conform to SECTION: LIME STABILIZED SUBGRADE or SECTION: EXCAVATION AND PREPARATION OF SUBGRADE as appropriate. Ruts or soft, yielding spots in the underlying course, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the contractor in a satisfactory condition until the graded-crushed-aggregate base course is placed.

17. **GRADE CONTROL:** During construction, the lines and grades including crown and cross slope indicated for the graded-crushed-aggregate base course shall be maintained by means of line and grade stakes placed by the contractor in accordance with the CONTRACT CLAUSES. However, any surveying requiring payment under SECTION: SURVEYING, shall be approved prior to accomplishment.

18. **MIXING OF MATERIALS:** The coarse and fine aggregates shall be mixed in a stationary plant. The contractor shall make such adjustments in mixing procedures or in equipment as may be directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory graded-crushed-aggregate base course meeting all requirements of this specification.

19. **PLACING:** After the underlying course has been approved, the mixed graded-crushed-aggregate base course material shall be placed on thereon in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or be less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the new graded-crushed-aggregate base course is placed in more than one layer the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation to adjust the water content, and to insure an acceptable graded-crushed-aggregate base course.

20. **COMPACTION:**

20.1 **Requirements:** Each layer of graded-crushed-aggregate base course in the pavement structure shall be compacted as specified to produce an average field-measured density, through the full depth, of at least the percentage of laboratory maximum dry density indicated in TABLE II. In all places not accessible to the rollers,

the graded-crushed-aggregate base course material shall be compacted with mechanical tampers.

20.2 In-Place Density: In-place density shall be determined at the frequency specified in SECTION: CONTRACTOR QUALITY CONTROL.

20.3 Finishing: After the graded-crushed-aggregate base course has been placed and compacted as required herein the surface shall be within 1/2 inch of the specified grade. In no case will thin layers of material be added to the top layer of graded-crushed-aggregate base course to meet grade. If the elevation of top layer of base course is 1/2 inch or more below the grade specified, the top layer of base shall be scarified to a depth of at least 3 inches, new material added, and the layer shall be blended and recompactd to bring the surface to the required grade. Adjustments in rolling and finishing procedures shall be made as may be directed to obtain grades, to minimize segregation and degradation of base course material and to ensure an acceptable graded-crushed-aggregate base course.

21. SMOOTHNESS TEST: The surface of the top layer of the graded-crushed-aggregate base course shall not vary more than 1/4 inch when measured with a 10-foot straight edge. Should the measured graded-crushed-aggregate base course exceed these tolerances the graded-crushed-aggregate base course shall be scarified as specified in paragraph 16. above, and brought to the specified smoothness.

22. MAINTENANCE: The graded-crushed-aggregate base course shall be maintained in a condition that will meet all specification requirements until accepted. Upon acceptance the contractor shall immediately apply the prime coat as specified in SECTION: PRIME COAT. Should the prime coat not be applied and the graded-crushed-aggregate base course damaged for any reason the contractor shall be responsible for bringing the damaged graded-crushed-aggregate base course into conformance with this specification at no additional cost to the Government.

TABLE II	
GRADED-CRUSHED-AGGREGATE BASE COURSE MATERIAL	REQUIRED % LABORATORY DENSITY
Under Roadway Pavement	95%
Under Valley Gutters	95%
Under Curb and Gutters	95%
Under Airfield Pavement	100%

SECTION 2E
BITUMINOUS COURSES FOR PAVEMENTS
(CENTRAL-PLANT HOT-MIX)

1. **APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 **Military Standard (Mil. Std.):**

MIL-STD-620A	15 Jul 95, Notice 2 29 May 67, Notice 1	Test Methods for Bituminous Paving Materials
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1.2 **Texas State Department of Highways and Public Transportation (TSDHPT) Publication:**

Standard Specifications for Construction of Highways, Streets, and Bridges	(1993)	ITEM 300 ASPHALTS, OILS, AND EMULSIONS ITEM 340 HOT MIX ASPHALTIC CONCRETE PAVEMENT
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1.3 **American Society for Testing and Materials (ASTM) Publications:**

C 117-95	1995	Materials Finer Than 75um (No. 200) Sieve in Mineral Aggregates by Washing
C 127-88	1988	Specific Gravity and Absorption of Coarse Aggregate
C 128-93	1993	Specific Gravity and Absorption of Fine Aggregate
C 136-96	1996	Method for Sieve Analysis of Fine and Coarse Aggregates
D 5-95	1995	Penetration of Bituminous Materials
D 140-93	1993	Sampling Bituminous Materials

D 1856 REV A-95	1995	Recovery of Asphalt from Solution by Abson Method
D 2041-95	1995	Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
D 2170-94	1994	Kinematic Viscosity of Asphalts (Bitumens)
D 2171-95	1995	Viscosity of Asphalts by Vacuum Capillary Viscometer
D 2172-95	1995	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
D 2216-92	1992	Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
D 2950-91	1991	Density of Bituminous Concrete In Place by Nuclear Method
D 3515-96	1996	Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

2. PLANT, EQUIPMENT, MACHINES, AND TOOLS:

2.1 General: The bituminous plant shall be of such capacity to produce the quantities of bituminous mixtures required. Hauling equipment, paving machines, rollers, miscellaneous equipment, and tools shall be provided in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output.

2.2 Mixing Plants: The mixing plant shall be an automatic or semiautomatic controlled commercially manufactured unit designed and operated to consistently produce a mixture within the job-mix formula (JMF). Drum mixers shall be prequalified at the production rate to be used during actual mix production. The prequalification tests will include extraction and recovery of the asphalt cement in accordance with ASTM D 2172 and ASTM D 1856. The penetration of the recovered asphalt binder shall not be less than 60 percent of the original penetration, as measured in accordance with ASTM D 5.

2.3 Straightedge: The contractor shall furnish and maintain at the site, in good condition, one 10-foot straightedge for each bituminous paver. Straightedge shall be

made available for Government use. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box-girder cross section with flat bottom reinforced to insure rigidity and accuracy. Straightedges shall have handles to facilitate movement on pavement.

3. WEATHER LIMITATIONS: Unless otherwise directed, the bituminous intermediate or wearing courses shall not be constructed when temperature of the surface of the underlying course is below 40 degrees F., or during periods of rain.

4. PROTECTION OF PAVEMENT: After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until the pavement has cooled to 140 degrees F, minimum.

5. GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS: Finished surface of bituminous courses, when tested as specified below and in paragraph ACCEPTABILITY OF WORK, shall conform to gradeline and elevations shown and to surface-smoothness requirements specified.

5.1 Plan Grade: The grade of the completed surface shall not deviate more than 0.05 foot from the plan grade.

5.2 Surface Smoothness: When a 10-foot straightedge is laid on the surface parallel with the centerline of the paved area or transverse from crown to pavement edge, the surface shall vary not more than 1/4 inch from the straightedge.

6. GRADE CONTROL: Lines and grades shall be established and maintained by means of line and grade stakes placed at site of work in accordance with the CONTRACT CLAUSES. Elevations of bench marks, or other structures used by the contractor for controlling pavement operations at the site of work will be determined, established, and maintained by the Government. Finished pavement elevations shall be established and controlled at the site of work by the contractor in accordance with bench mark elevations furnished by the Contracting Officer. However, any surveying requiring payment under SECTION: SURVEYING, shall be approved prior to accomplishment.

7. SAMPLING AND TESTING:

7.1 General Requirements: The contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing, at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory, regularly engaged in such testing. Based upon the results of these inspections and tests, the contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met. 4 copies of reports shall be submitted. The contractor shall not proceed with any work requiring testing or submittals until such tests and submittals have been approved by the Contracting Officer.

7.2 Aggregates:

7.2.1 General: Aggregates will be approved on the basis on certified test reports from the aggregate supplier attesting that the aggregates proposed for use conform to the requirements of these specifications.

7.2.2 Sources: Sources of aggregates shall be selected well in advance of the time the materials are required in the work. Approval of the source of aggregate does not relieve the contractor of responsibility for delivery at the jobsite of aggregates that meet the requirements specified herein.

7.3 Bituminous Materials: Samples of bituminous materials shall be obtained from the plant by the contractor; sampling shall be in accordance with ASTM D 140. Sources where bituminous materials are obtained shall be selected in advance of the time when materials will be required in the work, and samples of the asphalt cement specified shall be tested for compliance with this specification. In addition to initial qualification testing of bituminous materials, samples shall be taken before and during construction when shipments of bituminous materials are received or when necessary to assure some condition of handling or storage has not been detrimental to the bituminous material.

7.4 Bituminous Mixtures: Sampling and testing of bituminous mixtures will be accomplished by the contractor at the number, times and frequencies described below and in SECTION: CONTRACTOR QUALITY CONTROL.

8. DELIVERY, STORAGE, AND HANDLING OF MATERIALS:

8.1 Mineral Aggregates: Mineral Aggregates shall be delivered to the site of the bituminous mixing plant and stockpiled in such a manner as to preclude fracturing of aggregate particles, segregation, contamination, or intermingling of different materials in the stockpiles or cold-feed hoppers. Mineral filler shall be delivered, stored, and introduced into the mixing plant in a manner to preclude exposure to moisture or other detrimental conditions.

8.2 Bituminous Materials: Bituminous materials shall be maintained at appropriate temperature during storage but shall not be heated by application of direct flame to walls of storage tanks or transfer lines. Storage tanks, transfer lines, and weigh bucket shall be thoroughly cleaned before a different type or grade of bitumen is introduced into the system. The asphalt cement shall be heated sufficiently to allow satisfactory pumping of the material; however, the storage temperature shall be maintained below 300 degrees F.

9. ACCEPTABILITY OF WORK:

9.1 General: A lot shall be that quantity of construction that will be evaluated for compliance with specification requirements. A lot shall be equal to 500 tons of production of each type of mix specified, 50 or 75 blow Marshall. Testing shall be the

responsibility of the contractor. Additional tests required to determine acceptability of nonconforming material will be the responsibility of the contractor.

9.1.1 In order to evaluate aggregate gradation, asphalt content, and density, each lot shall be divided into four equal sublots. For density determination, one random test shall be taken from the mat, and one random test shall be taken from the joint of each subplot. Field density shall be determined using nuclear methods in accordance with ASTM D 2950. Samples for determining asphalt content and aggregate gradation shall be taken from loaded trucks within each subplot. Asphalt content shall be determined in accordance with ASTM D 2172, Method A or B. Aggregate gradation shall be determined for the mix by testing the recovered aggregate in accordance with ASTM C 136 and ASTM C 117.

9.1.2 When a lot of material fails to meet the specification requirements, that lot shall be removed and replaced or accepted at a reduced price, at the option of the Government. The lowest percentage payment for any pavement characteristic (i.e. gradation, asphalt content, density, grade, and smoothness) defined below shall be the percentage payment for that lot. The percentage payment is based on the pavement characteristics.

9.1.3 The Contracting Officer reserves the right to sample and test any area that appears to deviate from the specification requirements. Testing in these areas will be in addition to the lot testing, and will be performed at the expense of the Government for testing that indicates satisfactory results. If testing indicates unsatisfactory results the contractor shall be responsible for the cost of testing and the cost of any subsequent testing required. The requirements for these areas will be the same as those for a lot.

9.2 Aggregate Gradation: The mean absolute deviation of the four subplot aggregate gradations from each JMF for each sieve size will be evaluated and compared with Table I. The percentage payment based on aggregate gradation tests for aggregate will be the lowest value determined for any sieve size in Table I. All tests for aggregate gradation shall be completed and reported within 24 hours after completion of construction of each lot. The computation of mean absolute deviation for one sieve size is illustrated below:

Example: Assume the following JMF and subplot test results for aggregate gradation

Percent by Weight Passing and Retained on Sieves

Sieve Size	JMF	Test No 1	Test No 2	Test No 3	Test No 4
Passing 1/2 inch	100	100	100	100	100
Passing 3/8	90	89	91	89	90

inch					
Retained No. 4	45	44	46	48	43
Retained No. 10	22	19	21	24	20
Total Retained No. 10	65	66	63	67	61
Retained No. 40	28	25	31	27	28
Retained No. 80	16	17	20	14	19
Retained No. 200	9	8	10	10	9
Passing No. 200	6	4	7	8	6

$$\begin{aligned}
 \text{Mean Absolute Deviation} &= [4 - 6] + [7 - 6] + [8 - 6] + [6 - 6] \\
 (\text{for No. Passing 200 Sieve}) &4 \\
 &= 2 + 1 + 2 + 0 \\
 &4 \\
 &= 1.25
 \end{aligned}$$

The mean absolute deviation for other sieve sizes can be determined in a similar way for this example to be:

P = Passing, R = Retained, T = Total

	P	P							
Sieve Size	1/2 inch	3/8 inch	R No. 4	R No. 10	T R No. 10	R No. 40	R No. 80	R No. 200	
Mean Absolute Deviation	0	0.75	1.75	2.00	2.25	1.75	2.50	0.75	

The least percentage payment based on any sieve size tested in Table I would be 98 percent for the Passing No. 200 sieve. Therefore for this example the percentage payment based on aggregate gradation is 98 percent.

<p>TABLE I. PERCENT PAYMENT BASED ON MEAN ABSOLUTE DEVIATION OF AGGREGATE GRADATIONS FROM JMF</p>

Sieve Size	Percent Payment Based On Mean Absolute Deviation From JMF						
	0.0-1.0	1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	Above 6.0
P 1 inch	100	100	100	100	100	100	100
P 7/8 inch	100	100	100	100	100	98	95
R 3/8 inch	100	100	100	100	98	95	90
P 3/8 inch	100	100	100	100	98	95	90
R No. 4	100	100	100	100	98	95	90
R No. 10	100	100	100	98	95	90	reject
T R No. 10	100	100	100	98	95	90	reject
No. 40	100	100	100	98	95	90	reject
R No. 80	100	100	100	98	95	90	reject
R No. 200	100	98	95	90	90	reject	reject
P No. 200	100	98	90	reject	reject	reject	reject

9.3 Asphalt Content: The mean absolute deviation of the four asphalt contents from each JMF will be evaluated and compared with Table II. The percentage payment based on asphalt content will be the value determined in Table II. Asphalt content tests shall be completed and reported within 24 hours after construction of the lot.

TABLE II. PERCENT PAYMENT BASED ON ASPHALT CONTENT	
Mean Absolute Deviation of Extracted Asphalt Content From JMF	Percent Payment
less than 0.25	100
0.25-0.30	98
0.31-0.35	95
0.36-0.40	90
above 0.40	reject

9.4 Density: The average field mat and joint densities shall be expressed as a percentage of the Marshall laboratory density. The laboratory density for each lot shall be determined in accordance with MIL-STD-620, Method 100, from four sets of laboratory samples. One sample shall be obtained from each of the four sublots and shall be divided into three specimens to produce one set of laboratory samples.

Laboratory samples shall be prepared from asphalt mixture that has not been reheated. Samples shall be compacted at 250 degrees F. within 2 hours of the time the mixture was prepared at the asphalt plant. Laboratory samples shall be prepared in accordance with MIL-STD-620, Method 100.

9.4.1 The field density shall be determined and compared with Table III. The percentage payment based on density will be the lowest value determined from Table III. The percentage payment based on mat density will be for all of the material placed in the lot. The percentage payment based on joint density will be for the amount of material represented by an area equal to the lot joint length by 10 feet wide not to exceed the lot size.

TABLE III. PERCENT PAYMENT BASED ON DENSITY

Average Mat Density (4 Tests)	Percent Payment	Average Joint Density (4 Tests)
97.0-100.0	100.0	95.0-100.0
96.9	100.0	94.9
96.8,100.1	99.9	94.8
96.7	99.8	94.7
96.6,100.2	99.6	94.6
96.5	99.4	94.5
96.4,100.3	99.1	94.4
96.3	98.7	94.3
96.2,100.4	98.3	94.2
96.1	97.8	94.1
96.0,100.5	97.3	94.0
95.9	96.3	93.9
95.8,100.6	94.1	93.8
95.7	92.2	93.7
95.6,100.7	90.3	93.6
95.5	87.9	93.5
95.4,100.8	85.7	93.4
95.3	83.3	93.3
95.2,100.9	80.6	93.2
95.1	78.0	93.1
95.0,101.0	75.0	93.0
below 95.0, above 101.0	reject	below 93.0

9.4.2 All density results on a lot shall be completed and reported within 24 hours after construction of that lot.

9.5 Grade: When directed, grade-conformance tests shall be conducted by the contractor. The finished surface of the pavement shall be tested for conformance with plan-grade requirements. Within 5 working days after completion of placement of a

particular lot; the contractor shall inform the Contracting Officer, in writing, of results of grade-conformance tests. The finished grade of each pavement area shall be determined by running lines of levels at intervals of 25 feet or less longitudinally and transversely to determine the elevation of the completed pavement. When more than 5 percent of all measurements made within a lot are outside the tolerances specified in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS, the payment for that lot will not exceed 95 percent of the unit bid price. In areas where the grade exceeds the plan-grade tolerances given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent, the contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas will not be permitted.

9.6 Surface Smoothness: After completion of final rolling of a lot, and when directed, the compacted surface shall be tested by the contractor with a 10-foot straightedge. Within 10 working days after completion of placement of a particular lot, the contractor shall inform the Contracting Officer, in writing, of results of smoothness-conformance tests. Measurements shall be made perpendicular to and across all mats at distances along the mat not to exceed 25 feet. Location and deviation from straightedge of all measurements shall be recorded. When more than 5 percent of all measurements along the mat within a lot exceed the specified tolerance, the unit price for that lot will not exceed 95 percent of the unit bid price. Any joint or mat area surface deviation that exceeds the tolerance given in paragraph GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS by more than 50 percent shall be corrected to meet the specification requirements. The contractor shall remove the deficient area and replace with fresh paving mixture at no additional cost to the Government. Sufficient material shall be removed to allow at least 1 inch of asphalt concrete to be placed. Skin patching for correcting low areas or planing for correcting high areas will not be permitted.

10. ACCESS TO PLANT AND EQUIPMENT: The Contracting Officer shall have access at all times to all parts of the paving plant for checking adequacy of the equipment in use; inspecting operation of the plant; verifying weights, proportions, and character of materials; and checking temperatures maintained in preparation of the mixtures.

11. WAYBILLS AND DELIVERY TICKETS: Since payment for the quantity of Hot-Mixed Asphalt Concrete, or HMAC used in completion of the work will be made at the quantity negotiated and contained in each Task Order, submission of waybills and delivery tickets is not required.

12. MEASUREMENT:

12.1 Hot-Mixed Asphalt Cement (HMAC) Pavement: The quantity of hot-mixed asphalt cement (HMAC) pavement to be paid for will be the negotiated number of

2,000-pound tons of hot-mixed asphalt concrete (HMAC) pavement mixture, as stated in the Task Order.

12.2 Measurement of prime coat installation will be made in accordance with the measurement clause "Prime Coat" contained in SECTION: BITUMINOUS PRIME COAT.

13. BASIS FOR PAYMENT:

13.1 Hot-Mixed Asphalt Cement (HMAC) Pavement: Payment for the quantity of hot-mixed asphalt cement (HMAC) pavement, determined as specified above, will be made at the appropriate contract unit price per ton, as established in the bid schedule for Airfield or Roadway work, or at a reduced price adjusted in accordance with paragraph ACCEPTABILITY OF WORK. Such payment shall constitute full compensation for all labor, materials (Including tack coat), equipment, overhead, profit, supervision, and other incidentals necessary to complete work required.

13.2 Installation of Prime Coat: Payment for the quantity of prime coat installation determined as specified above will be made in accordance with the payment clause "Prime Coat" contained in SECTION: BITUMINOUS PRIME COAT.

PART 2 - PRODUCTS

14. HOT-MIXED ASPHALT CONCRETE (HMAC) PAVEMENT: Hot-mixed asphalt concrete (HMAC) pavement courses shall consist of coarse aggregate, fine aggregate, mineral filler, bituminous material, and approved additives, if required, conforming to TSDHPT specification ITEM 340, Gradation Type "D" and shall conform to the requirements contained in paragraphs PROPORTIONING OF MIXTURE and ACCEPTABILITY OF WORK.

14.1 Aggregates: Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, sand, and mineral filler, as required. Aggregates shall conform to TSDHPT Specification ITEM 340. Aggregate gradation shall conform to gradations specified in Table IV.

TABLE IV	
HMAC PAVEMENT AGGREGATE GRADATION TYPE D MIX	
	Percent Aggregate by Weight or Volume
Passing 1/2" sieve	100
Passing 3/8" sieve	85 to 100
Passing 3/8" sieve, retained on No. 4 sieve	21 to 53
Passing No. 4 sieve, retained on No. 10 sieve	11 to 32
Total retained on No. 10 sieve	54 to 74

Passing No. 10 sieve, retained on No. 40 sieve	6 to 32
Passing No. 40 sieve, retained on No. 80 sieve	4 to 27
Passing No. 80 sieve, retained on No. 200 sieve	3 to 27
Passing No. 200 sieve	1 to 8

14.2 Bituminous Materials: Asphalt cement shall be AC-20, graded in accordance with ASTM D 2170, or ASTM 2171, conforming to TSDHPT specification ITEM 300. Asphalt cement shall come from a source approved by the Texas Highway Department. The asphalt shall show a negative spot test in accordance with TSDHPT specification ITEM 300.

14.3 Additives: The use of additives such as antistripping and antifoaming agents is subject to approval.

15. PROPORTIONING OF MIXTURE:

15.1 Job Mix Formula: The JMF for each bituminous mixture shall be furnished to the Contracting Officer by the contractor and no HMAC shall be produced for the project until each job mix formula is approved. The contractor shall provide samples of materials for mix design to the testing laboratory. Sufficient quantities of each aggregate and mineral filler shall be provided to produce a minimum of 200 pounds of blended aggregate in the same approximate proportions as will be used in each bituminous mix. Blending of the aggregates shall be accomplished by the testing laboratory. A minimum of 5 gallons of the asphalt cement, for each bituminous mix, to be used in the project shall be provided to the testing laboratory. No payment will be made for mixtures produced prior to the approval of the JMF. The formula shall indicate the percentage of each stockpile and mineral filler, the percentage of each size aggregate, the percentage of bitumen, and the temperature of the completed mixture when discharged from the mixer. Tolerances are given in Table V for asphalt content, temperature, and aggregate grading for tests conducted on the mix as discharged from the mixing plant; however, the final evaluation of aggregate gradation and asphalt content will be based on paragraph ACCEPTABILITY OF WORK. Bituminous mix that deviates more than 25 degrees F. from the JMF will be rejected. The JMF may be adjusted during construction to improve paving mixtures, as directed, without adjustments in the contract unit price.

TABLE V. JOB-MIX TOLERANCES	
Material	Tolerance, Plus or minus
Aggregate passing No. 4 sieve or larger	5 percent
Aggregate passing Nos. 10, 40, and 80 sieves	4 percent
Aggregate passing No. 200 sieve	2 percent
Bitumen	0.25 percent
Temperature of Mixing	25 degrees F.

The contractor shall provide the following information to the Contracting Officer for inspection. Mix design criteria shall be in accordance with MIL-STD-620. Five curves are required for suitability determination for each mix and are listed below.

- a) Unit Weight, PCF Total Mix vs. Bitumen Content, %
- b) Stability, LB vs. Bitumen Content, %
- c) Flow 1/100 IN. vs. Bitumen Content %
- d) Percent Voids, Total Mix vs. Bitumen Content, %
- e) Percent Total Voids Filled with Bitumen vs. Bitumen Content, %

Bitumen contents shall be determined at the points on the curves indicated in Tables VI and VII. Table VI shall be used for non-absorptive aggregates and Table VII shall be used for absorptive aggregates. The contractor shall prepare curves a, b, d, and e for a minimum of five trial mixes each at a different % bitumen content. The bitumen contents at the points on curves shall then be averaged and this number will be the optimum bitumen content. Three additional samples shall be prepared at the optimum bitumen content, and tested to determine if the optimum bitumen content will produce a mix with the desired properties. The average stability, flow, voids in the total mix and percentage voids filled of the three samples shall be used to determine mix suitability in accordance with the appropriate Table VIII or IX. If the optimum bitumen content produces a mixture that passes the minimums for these qualities, that bitumen content shall be used in the job mix formula.

15.2 Test Properties of Bituminous Mixtures: Finished mixture shall meet requirements described below when tested in accordance with MIL-STD-620, Methods 100 and 101. Method 105 shall be a requirement when water absorption exceeds 2 1/2% of the entire aggregate blend. Samples for Roadway work shall be compacted with 50 blows of specified hammer on each side of sample. Samples for Airfield work shall be compacted with 75 blows of specified hammer on each side of sample. When bituminous mixture fails to meet the requirements specified below, the paving operation shall be stopped until the cause of noncompliance is determined and corrected.

15.2.1 Requirements for stability, flow, and voids are shown in Tables VIII and IX for non-absorptive and absorptive aggregates, respectively.

TABLE VI.		
FOR USE WITH AGGREGATE BLENDS SHOWING WATER ABSORPTION UP TO 2 1/2 PERCENT		
FOR DETERMINING OPTIMUM BITUMEN CONTENT		
Test Property	Type of Mix	Point on Curve
Marshall Stability	HMAC Roadway Course	Peak of Curve
Marshall Stability	HMAC Airfield Course	Peak of Curve

Unit Weight	HMAC Roadway Course	Peak of Curve
Unit Weight	HMAC Airfield Course	Peak of Curve
Flow	-----	Not Used
Percent Voids Total Mix	HMAC Roadway Course	4
Percent Voids Total Mix	HMAC Airfield Course	4
Percent Voids Filled With Bitumen	HMAC Roadway Course	80
Percent Voids Filled With Bitumen	HMAC Airfield Course	75

TABLE VII.		
FOR USE WITH AGGREGATE BLENDS SHOWING WATER ABSORPTION GREATER THAN 2 1/2 PERCENT		
FOR DETERMINING OPTIMUM BITUMEN CONTENT		
Test Property	Type of Mix	Point on Curve
Marshall Stability	HMAC Roadway Course	Peak of Curve
Marshall Stability	HMAC Airfield Course	Peak of Curve
Unit Weight	HMAC Roadway Course	Peak of Curve
Unit Weight	HMAC Airfield Course	Peak of Curve
Flow	-----	Not Used
Percent Voids Total Mix	HMAC Roadway Course	3
Percent Voids Total Mix	HMAC Airfield Course	3
Percent Voids Filled With Bitumen	HMAC Roadway Course	85
Percent Voids Filled With Bitumen	HMAC Airfield Course	80

TABLE VIII.	
NON-ABSORPTIVE-AGGREGATE MIXTURE:	
ROADWAY COURSE	
Stability minimum, pounds	500
Flow maximum, 1/100-inch units	20
Voids total mix, percent (1)	3-5
Voids filled with bitumen, percent	75-85
AIRFIELD COURSE	
Stability minimum, pounds	1,800
Flow maximum, 1/100-inch units	16

Voids total mix, percent (1)	3-5
Voids filled with bitumen, percent	70-80

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

TABLE IX.	
ABSORPTIVE-AGGREGATE MIXTURE	
ROADWAY COURSE	
Stability minimum, pounds	500
Flow maximum, 1/100-inch units	20
Voids total mix, percent (1)	2-4
Voids filled with bitumen, percent	80-90
AIRFIELD COURSE	
Stability minimum, pounds	1,800
Flow maximum, 1/100-inch units	16
Voids total mix, percent (1)	2-4
Voids filled with bitumen, percent	75-85

(1) The Contracting Officer may permit deviations from limits specified when gyratory method of design is used to develop the JMF.

15.2.1.1 When the water-absorption value of the entire blend of aggregate does not exceed 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as non-absorptive. The theoretical specific gravity computed from the apparent specific gravity or ASTM D 2041 will be used in computing voids total mix and voids filled with bitumen, and the mixture shall meet requirements in Table VIII.

15.2.1.2 When the water-absorption value of the entire blend exceeds 2.5 percent as determined in accordance with ASTM C 127 and ASTM C 128, the aggregate is designated as absorptive. The theoretical specific gravity computed from the bulk-impregnated specific gravity method contained in MIL-STD-620, Method 105, or ASTM D 2041 shall be used in computing percentages of voids total mix and voids filled with bitumen; the mixture shall meet requirements in Table IX.

15.2.2 The index of retained stability must be greater than 75 percent as determined by MIL-STD-620, Method 104. When the index of retained stability is less than 75, the aggregate stripping tendencies may be countered by the use of hydrated lime or by treating the bitumen with an approved antistripping agent. The hydrated lime is considered as mineral filler and should be considered in the gradation requirements. The amount of hydrated lime or antistripping agent added to bitumen shall sufficient, as approved, to produce an index of retained stability of not less than 75 percent. No

additional payment will be made to the contractor for addition of antistripping agent required.

PART 3 - EXECUTION

16. CONCRETE AND BASE COURSE CONDITIONING: When HMAC overlay is specified, existing concrete surfaces to be overlaid shall be swept clean and all holes larger than 1/2 inch in diameter, such as tie-down holes, shall be filled with a non-shrink grout. Base course shall be inspected and approved prior to application of prime coat. Concrete surfaces shall be inspected and approved prior to application of tack coat. If directed, cracks and/or joints in pavements may be sealed/resealed and or taped to reduce reflective cracking through the HMAC overlay. Measurement of these items will be made as specified in the measurement clause contained in the specification section dealing with their accomplishment.

17. PREPARATION OF BITUMINOUS MIXTURES: Rates of feed of aggregates shall be regulated so that the moisture content and temperature of aggregates will be within specified tolerances. Aggregates, mineral filler, and bitumen shall be conveyed into the mixer in proportionate quantities required to meet the JMF. Mixing time shall be as required to obtain a uniform coating of the aggregate with the bituminous material. Temperature of bitumen at the time of mixing shall not exceed 300 degrees F. Temperature of aggregate and mineral filler in the mixer shall not exceed 325 degrees F. when bitumen is added. Overheated and carbonized mixtures or mixtures that foam shall not be used.

18. WATER CONTENT OF AGGREGATES: Drying operations shall reduce the water content of mixture to less than 0.75 percent. The water content test shall be conducted in accordance with ASTM D 2216; the weight of the sample shall be at least 500 grams. If the water content is determined on hot bin samples, the water content will be a weighted average based on composition of blend.

19. STORAGE OF BITUMINOUS PAVING MIXTURE: Shall conform to the applicable requirements of ASTM D 3515; however, in no case shall the mixture be stored for more than 4 hours.

20. TRANSPORTATION OF BITUMINOUS MIXTURE: Transportation from paving plant to site shall be in trucks having tight, clean, smooth beds lightly coated with an approved releasing agent to prevent adhesion of the mixture to the truck bodies. Excessive releasing agent shall be drained prior to loading. Each load shall be covered with canvas or other approved material of ample size to protect mixture from weather and prevent loss of heat. Loads that have crusts of cold, unworkable material or that have become wet will be rejected. Hauling over freshly placed material will not be permitted.

21. SURFACE PREPARATION OF UNDERLYING COURSE: Prior to placing of the HMAC course(s), the underlying course shall be cleaned of all foreign or

objectionable matter with power brooms and hand brooms and tack coated or prime coated as appropriate.

22. PRIME COATING: Contact surfaces of previously constructed or existing base course shall be sprayed with a coat of bituminous material conforming to SECTION: BITUMINOUS PRIME COAT.

23. TACK COATING: Contact surfaces of previously constructed or existing pavement, intermediate courses, curbs, manholes, and other structures shall be sprayed with a thin coat of bituminous material conforming to SECTION: BITUMINOUS TACK COAT.

24. PLACING: Bituminous courses shall be constructed only when the base course has no free water on the surface. Bituminous mixtures shall not be placed without ample time to complete spreading and rolling during daylight hours, unless approved satisfactory artificial lighting is provided. Bituminous mixtures shall be placed such that no course will be less than 3/4" nor more than 2" in thickness when compaction is complete.

24.1 Offsetting Joints: Wearing course(s) shall be placed so that longitudinal joints of the wearing course will be offset from joints in intermediate course(s) by at least 1 foot. Transverse joints in the wearing course shall be offset by at least 2 feet from transverse joints in the intermediate course.

24.2 General Requirements for Use of Mechanical Spreader: Hot-mixed asphalt concrete shall be discharged from the mixer and at 265 to 325 degrees F. Mixtures having temperatures less than 245 degrees F. when dumped into the mechanical spreader shall not be used. The mechanical spreader shall be adjusted and the speed regulated so that the surface of the course being laid will be smooth and continuous without tears and pulls, and of such depth that, when compacted, the surface will conform to the cross section indicated. Placing with respect to centerline areas with crowned sections or high side of areas with one-way slope shall be as directed. Each lot of material placed shall conform to requirements specified in paragraph ACCEPTABILITY OF WORK. Placing of the mixture shall be as nearly continuous as possible, and speed of placing shall be adjusted, as directed, to permit proper rolling. When segregation occurs in the mixture during placing, the spreading operation shall be suspended until the cause is determined and corrected. HMAC shall be dumped directly from the trucks into the mechanical spreader, stockpiling of HMAC on the base course or paved areas will not be permitted.

24.3 Placing Strips Succeeding Initial Strips: In placing each succeeding strip after initial strip has been spread and compacted as specified below, the screed of the mechanical spreader shall overlap the previously placed strip 2 to 3 inches and be sufficiently high so that compaction produces a smooth dense joint. Mixture placed on the edge of a previously placed strip by the mechanical spreader shall be pushed back to the edge of the strip by use of a lute. Excess mixture shall be removed and wasted.

24.4 Hand Spreading in place of Machine Spreading: In areas where the use of machine spreading is impractical, the mixture shall be spread by hand. Spreading shall be in a manner to prevent segregation. The mixture shall be spread uniformly with hot rakes in a loose layer of thickness that, when compacted, will conform to required grade, density, and thickness.

25. COMPACTION OF MIXTURE: Rolling shall begin as soon after placing as the mixture will bear a roller without undue displacement. Delays in rolling freshly spread mixture will not be permitted. After initial rolling, preliminary tests of crown, grade, and smoothness shall be made by the contractor. Deficiencies shall be corrected so that the finished course will conform to requirements for grade and smoothness specified herein. Crown, grade, and smoothness shall be checked in each lot of completed pavement by the contractor for compliance and will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. After the contractor is assured of meeting crown, grade, and smoothness requirements, rolling shall be continued until a mat density of 97.0 to 100.0 percent and a joint density of 95.0 to 100.0 percent of density of laboratory-compacted specimens of the same mixture is obtained. The density will be determined and evaluated as specified in paragraph ACCEPTABILITY OF WORK. Places inaccessible to rollers shall be thoroughly compacted with hot hand tampers.

25.1 Testing of Mixture: At the start of the plant operation, a quantity of mixture shall be prepared that is sufficient to construct a test section at least 50 feet long, two spreader widths wide and of thickness to be used in the project. Mixture shall be placed, spread, and rolled with equipment to be used in the project and in accordance with the requirements specified above. This test section shall be tested and evaluated as a lot and shall conform to all specified requirements. If test results are satisfactory, the test section shall remain in place as part of the completed pavement. If tests indicate that the pavement does not conform to specification requirements, necessary adjustments to plant operations and rolling procedures shall be made immediately, and the test section will be evaluated as specified in paragraph ACCEPTABILITY OF WORK. Additional test sections, as directed, shall be constructed and sampled for conformance to specification requirements. In no case shall the contractor start full production of the wearing or intermediate course mixtures without approval.

25.2 Correcting Deficient Areas: Mixtures that become contaminated or are defective shall be removed to the full thickness of the course. Edges of the area to be removed shall be cut so that sides are perpendicular and parallel to the direction of traffic and so that the edges are vertical. Edges shall be sprayed with bituminous materials conforming to SECTION: BITUMINOUS TACK COAT. Fresh paving mixture shall be placed in the excavated areas in sufficient quantity so that the finished surface will conform to grade and smoothness requirements. Paving mixture shall be compacted to the density specified herein. Skin patching of an area that has been rolled shall not be permitted.

26. JOINTS:

26.1 General: Joints between old and new pavements, between successive days' work, or joints that have become cold (less than 175 degrees F.) shall be made to insure continuous bond between the old and new sections of the course. All joints shall have the same texture and smoothness as other sections of the course. Contact surfaces of previously constructed pavements coated by dust, sand, or other objectionable material shall be cleaned by brushing or shall be cut back as directed. When directed by the Contracting Officer, the surface against which new material is placed shall be sprayed with a thin, uniform coat of bituminous material conforming to SECTION: BITUMINOUS TACK COAT. Material shall be applied far enough in advance of placement of a fresh mixture to insure adequate curing. Care shall be taken to prevent damage or contamination of the sprayed surface.

26.2 Transverse Joints: The roller shall pass over the unprotected end of a strip of freshly placed material only when placing is discontinued or delivery of the mixture is interrupted to the extent that the material in place may become cold. In all cases, prior to continuing placement, the edge of previously placed pavement shall be cut back to expose an even vertical surface for full thickness of the course. In continuing placement of a strip, the mechanical spreader shall be positioned on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

26.3 Longitudinal Joints: Edges of a previously placed strip shall be prepared such that the pavement in and immediately adjacent to the joint between this strip and the succeeding strip meets the requirements for grade, smoothness, and density specified in paragraph ACCEPTABILITY OF WORK.

SECTION 2F

BITUMINOUS PRIME COAT

PART 1 - GENERAL

1. APPLICABLE PUBLICATIONS: The publications listed below, form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Society for Testing and Materials (ASTM) Publications:

D 2027-76	(R1992)	Cutback Asphalt (Medium Curing Type)Emulsified Asphalt
D 2995-93	1993	Determining Application Rate of Bituminous Distributors

2. PLANT, EQUIPMENT, MACHINES AND TOOLS:

2.1 General Requirements: All plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the results specified.

2.2 Bituminous Distributor: The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving, or otherwise damaging the base surface or other layers in the pavement structure. It shall be designed and equipped to spray the bituminous material in a uniform double or triple lap at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

2.3 Power Brooms and Power Blowers: Power brooms and power blowers shall be suitable for cleaning the surfaces to which the prime coat is to be applied.

3. SUBMITTALS: Prior to the use of materials, certified copies of test reports demonstrating compliance with the applicable specifications shall be submitted and approved. Tests need not be performed for this specific job, but shall be a maximum of one year old. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the materials, printed copies of these recommendations shall be furnished prior to use on the project.

4. WEATHER LIMITATIONS: The prime coat shall be applied only when the base course is dry enough to promote uniform coverage and the desired penetration into the treated surface. The prime coat shall be applied only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to the application.

5. DELIVERY AND STORAGE: Materials delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling. Materials shall be handled in such a manner as to insure no damage to the prime coating materials. Storage facilities shall be provided by the contractor at the jobsite for maintaining the materials at temperatures recommended by the manufacturer.

6. TESTING:

6.1 General Requirements: Sampling and testing shall be performed by an approved commercial testing laboratory, regularly engaged in such testing, at the expense of the contractor. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of tests.

6.2 Initial Sampling and Testing:

6.2.1 Calibration Test: The contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the prime coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

6.2.2 Trial Applications: As a preliminary to providing the complete prime coat, three lengths of at least 100 feet for the full width of the distributor bar shall be primed to evaluate the amount of prime that can be satisfactorily applied and to calibrate the equipment to deliver the specified application.

6.3 Testing During Construction: Testing during testing will not be required unless, in the opinion of the Government inspector, the prime coating equipment has become out of calibration and the prime coat application rate is not as specified. At the request of the Government inspector, the contractor shall recalibrate the equipment as specified above at no additional cost to the Government.

7. MEASUREMENT:

7.1 Bituminous Prime Coat: The quantity of bituminous prime coat to be paid for will be the negotiated number of square yards of bituminous prime coat, as stated in the Task Order.

8. BASIS FOR PAYMENT:

8.1 Bituminous Prime Coat: Payment for the quantity of bituminous prime coat, determined as specified above, will be made at the appropriate contract unit price, per square yard, as established in the bid schedule for Roadway or Airfield work. Such

payment shall constitute full compensation for furnishing all labor, equipment, testing, materials, supervision, overhead, profit, and incidentals necessary to complete the work.

PART 2 - PRODUCTS

9. BITUMINOUS MATERIAL: Cutback asphalt shall conform to ASTM 2027, MC-30 grade.

PART 3 - EXECUTION

10. PREPARATION OF SURFACE: Immediately before applying the prime coat, all loose material, dirt, clay, or other objectionable material shall be removed from the base course to be treated. To assure a uniform spread of the bituminous material, the portion of the base course prepared for treatment, if excessively dry, shall be lightly sprinkled with water immediately before the application, as directed.

11. APPLICATION RATE: Bituminous material for the prime coat shall be applied at the rate of 0.20 to 0.30 gallons per square yard of base course surface.

12. APPLICATION TEMPERATURE: Asphalt emulsions shall be applied at a temperature of at least 85 degrees F.

13. APPLICATION: Following preparation and subsequent inspection of the base course surface to receive prime, the prime coat shall be applied at the specified rate with uniform distribution over the surface. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, building paper shall be spread on the surface for a sufficient distance back from the ends of each application so that the prime coat may be started and stopped on the paper. Building paper shall also be spread on paved areas, not in the contract, to prevent prime coat from being applied to those surfaces. Immediately after application, the building paper shall be removed and destroyed. All areas and spots missed by the distributor shall be properly treated with the hand spray. Following application of the prime material, the surface shall be allowed to cure without being disturbed for a period of at least 12 hours or longer, as may be necessary to attain penetration into the treated course and evaporation of moisture from prime material. As directed, sand shall be spread to effectively blot up and cure any excess bituminous material. Until the succeeding layer of pavement is placed, the primed surface shall be maintained by protecting the surface against damage and by repairing and repriming deficient areas at no additional cost to the Government.

14. FIELD QUALITY CONTROL: The contractor shall ensure that all base course to receive bituminous course(s) is prime coated at the specified rate prior to placing bituminous course(s).

SECTION 2G

BITUMINOUS TACK COAT

PART 1 - GENERAL

1. **APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designations only.

1.1 American Society for Testing and Materials (ASTM) Publications:

D 977-91	1991	Emulsified Asphalt
D 2397-94	1994	Cationic Emulsified Asphalt

2. **PLANT, EQUIPMENT, MACHINES AND TOOLS:**

2.1 **General Requirements:** All plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the results specified.

2.2 **Bituminous Distributor:** The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent. Distributor equipment shall include a separate power unit for the bitumen pump, pressure gauges, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to the faces of concrete curb and gutter and other concrete surfaces to be tack coated. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

3. **SUBMITTALS:** Prior to the use of materials, certified copies of test reports demonstrating compliance with the applicable specifications shall be submitted and approved. Tests need not be performed for this specific job, but shall be a maximum of one year old. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the materials, printed copies of these recommendations shall be furnished prior to use on the project.

4. **WEATHER LIMITATIONS:** Tack coat shall be applied only when the surface to receive the tack coat is dry. Tack coat shall be applied only when the atmospheric temperature in the shade is 50 degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application.

5. DELIVERY AND STORAGE: Materials delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling. Materials shall be handled in such a manner as to insure no damage to the tack coating materials. Storage facilities shall be provided by the contractor at the jobsite for maintaining the materials at temperatures recommended by the manufacturer. Asphalt emulsions shall be protected from freezing.

6. BASIS FOR PAYMENT: The quantities of bituminous tack coat material, applied in the completed and accepted work will be paid for as a part of the appropriate contract unit price for Airfield or Roadway work as appropriate, established in the bid schedule for Hot Mixed Asphalt Cement (HMAC) pavement determined as specified in SECTION: BITUMINOUS COURSES FOR PAVEMENTS (CENTRAL PLANT HOT-MIX). Such payment shall constitute full compensation for all labor, materials, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

PART 2 - PRODUCTS

7. BITUMINOUS MATERIAL: Emulsified asphalt shall conform to ASTM D 977 or ASTM D 2397, SS-1 or CSS-1 respectively.

PART 3 - EXECUTION

8. PREPARATION OF SURFACE: Immediately before applying the tack coat all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. The area to be tacked shall also be dry and clean.

9. APPLICATION RATE: Bituminous material for the tack coat shall be diluted 50/50 with water and applied at a rate of 0.06 to 0.08 gallons per square yard of surface.

10. APPLICATION TEMPERATURE: Asphalt emulsions shall be applied at a temperature between 70 and 160 degrees F.

11. APPLICATION:

11.1 Existing pavement surfaces to be overlaid shall receive a bituminous tack coat prior to installation of the HMAC overlay. When HMAC pavement is installed in two or more lifts, such as when a wearing course follows an intermediate course, bituminous tack coat shall be installed between the lifts.

11.2 Following the inspection of the surface to receive tack coat, the tack coat shall be applied at the specified rate with uniform distribution over the vertical faces of all concrete that will come in contact with bituminous course(s). Following application of the tack material and prior to placing of bituminous course(s), the tack coat shall be allowed to cure and obtain evaporation of any moisture. Until the bituminous course(s) is placed, the tacked area shall be maintained by protecting the surface against damage and by repairing and retacking deficient areas at no additional cost to the

Government. Distributors for applying ionic asphalt emulsions shall not be used to apply cationic asphalt emulsions and vice versa.

12. FIELD QUALITY CONTROL: The contractor shall ensure that all vertical surfaces of concrete that will come in contact with bituminous intermediate or wearing courses are tack coated at the specified rate prior to placing the bituminous material. Also, the contractor shall ensure that all bituminous intermediate course receives tack coat prior to the laying of the bituminous wearing course.

SECTION 2H

HMAC PAVEMENT REPAIR

PART 1 - GENERAL

1. **SCOPE:** This section covers the repair of hot-mixed asphalt concrete (HMAC) pavements, complete.

2. **SUBMITTALS:**

2.1 **Manufacturer's Recommendations:** Where installation or application procedures or any part thereof are required to comply with the recommendations of the manufacturer of the material, printed copies of these recommendations shall be furnished the Contracting Officer prior to use on the project. Use of the material will not be permitted until the recommendations are received and approved. Failure to furnish these recommendations can be cause for rejection of materials.

2.2 **Certificate of Compliance:** Before delivery of materials, the contractor shall furnish copies certifying that the material is in compliance with required specifications. These certified copies shall be submitted to the Contracting Officer for approval not less than 30 days before starting work. Testing of all materials shall have been performed in an independent, Government certified laboratory.

3. **DELIVERY AND STORAGE OF MATERIALS:** Materials delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling. Storage accommodations shall be subject to the approval of the Contracting Officer and shall afford easy access for inspection and sampling.

4. **EQUIPMENT, TOOLS, AND MACHINES:** Equipment, tools and machines needed in the performance of the work shall be provided by the contractor, shall be maintained in a satisfactory working condition at all times, and shall be subject to approval of the Contracting Officer.

5. **MEASUREMENT:**

5.1 **Hot-Mixed Asphalt Cement (HMAC) Pavement Patching:** The quantity of hot-mixed asphalt cement (HMAC) pavement patching to be paid for will be the negotiated number of 2,000-pound tons of hot-mixed asphalt concrete (HMAC) pavement for patching asphalt pavements as specified herein, as stated in the Task Order.

5.2 **Measurement of the remaining items used in HMAC pavement patching will be made in accordance with measurement clauses for several bid items as follows.**

5.2.1 **Sawcutting of Bituminous Pavement:** Measurement of bituminous pavement sawcutting will be made in accordance with the measurement clause "Bituminous Pavement Sawcutting" contained in SECTION: DEMOLITION.

5.2.2 Removal of Failed Asphalt Surface: Measurement of asphalt surface removal will be made in accordance with the measurement clause "Bituminous Pavement Surface Demolition" contained in SECTION: DEMOLITION.

5.2.3 Excavation of Failed Base/Subgrade Materials: Measurement of failed base/subgrade material excavation will be made in accordance with the measurement clause "Excavation" contained in SECTION: EXCAVATION AND PREPARATION OF SUBGRADE.

5.2.4 Repair/Recompaction of Existing Base Course: Measurement of existing base course repair/recompaction will be made in accordance with the measurement clause "Existing Base Course Repair/Recompaction" contained in SECTION: GRADED-CRUSHED-AGGREGATE BASE COURSE.

5.2.5 Repair/Recompaction of Existing Subgrade: Measurement of existing subgrade repair/recompaction will be made in accordance with the measurement clause "Existing Subgrade Repair/Recompaction" contained in SECTION: EXCAVATION AND PREPARATION OF SUBGRADE.

5.2.6 Installation of Graded-Crushed-Aggregate Base Course: Measurement of graded-crushed-aggregate base course installation will be made in accordance with the measurement clause "Graded-Crushed-Aggregate Base Course" contained in SECTION: GRADED-CRUSHED-AGGREGATE BASE COURSE.

5.2.7 Installation of Flowable Fill: Measurement of flowable fill installation will be made in accordance with the measurement clause "Flowable Fill" contained in SECTION: CONCRETE, GENERAL REQUIREMENTS.

5.2.8 Installation of Fly Ash: Measurement of fly ash installation will be made in accordance with the measurement clause "Fly Ash" contained in SECTION: ASPHALT PAVEMENT RECYCLING USING CLASS "C" FLY ASH.

5.2.9 Installation of Prime Coat: Measurement of prime coat installation will be made in accordance with the measurement clause "Bituminous Prime Coat" contained in SECTION: BITUMINOUS PRIME COAT.

5.2.10 Installation of Tack Coat: Measurement of tack coat installation will be made in accordance with the measurement clause "Bituminous Tack Coat" contained in SECTION: BITUMINOUS TACK COAT.

6. BASIS FOR PAYMENT:

6.1 Hot-Mixed Asphalt Cement (HMAC) Pavement Patching: Payment for the quantity of hot-mixed asphalt cement (HMAC) pavement patching, determined as specified above, will be made at the appropriate contract unit price per ton, as established in the bid schedule for Airfield or Roadway work, or at a reduced price adjusted in accordance with paragraph ACCEPTABILITY OF WORK. Such payment shall constitute full compensation for all labor, materials (Including tack coat),

equipment, overhead, profit, supervision, and other incidentals necessary to complete work required.

6.2 Payment for the remaining items used in HMAC pavement patching will be made in accordance with payment clauses for several bid items as follows.

6.2.1 Sawcutting of Bituminous Pavement: Payment for the quantity of bituminous pavement sawcutting determined as specified above will be made in accordance with the payment clause "Bituminous Pavement Sawcutting" contained in SECTION: DEMOLITION.

6.2.2 Removal of Failed Asphalt Surface: Payment for the quantity of failed asphalt surface removal determined as specified above will be made in accordance with the payment clause "Bituminous Pavement Surface Demolition" contained in SECTION: DEMOLITION.

6.2.3 Excavation of Failed Base/Subgrade Materials: Payment for the quantity of failed base/subgrade material excavation determined as specified above will be made in accordance with the payment clause "Excavation" contained in SECTION: EXCAVATION AND PREPARATION OF SUBGRADE.

6.2.4 Repair/Recompaction of Existing Base Course: Payment for the quantity of existing base course repair/recompaction determined as specified above will be made in accordance with the payment clause "Existing Base Course Repair/Recompaction" contained in SECTION: GRADED-CRUSHED-AGGREGATE BASE COURSE.

6.2.5 Repair/Recompaction of Existing Subgrade: Payment for the quantity of existing subgrade repair/recompaction determined as specified above will be made in accordance with the payment clause "Existing Subgrade Repair/Recompaction" contained in SECTION: EXCAVATION AND PREPARATION OF SUBGRADE.

6.2.6 Installation of Graded-Crushed-Aggregate Base Course: Payment for the quantity of graded-crushed-aggregate base course installation determined as specified above will be made in accordance with the payment clause "Graded-Crushed-Aggregate Base Course" contained in SECTION: GRADED-CRUSHED-AGGREGATE BASE COURSE.

6.2.7 Installation of Flowable Fill: Payment for the quantity of flowable fill installation determined as specified above will be made in accordance with the payment clause "Flowable Fill" contained in SECTION: CONCRETE, GENERAL REQUIREMENTS.

6.2.8 Installation of Fly Ash: Payment for the quantity of fly ash installation determined as specified above will be made in accordance with the payment clause "Fly Ash" contained in SECTION: CONCRETE, GENERAL REQUIREMENTS.

6.2.9 Installation of Prime Coat: Payment for the quantity of prime coat installation determined as specified above will be made in accordance with the payment clause " Bituminous Prime Coat" contained in SECTION: BITUMINOUS PRIME COAT.

6.2.10 Installation of Tack Coat: Payment for the quantity of tack coat installation determined as specified above will be made in accordance with the payment clause " Bituminous Tack Coat" contained in SECTION: BITUMINOUS TACK COAT.

PART 2 - PRODUCTS

7. MATERIALS:

7.1 HMAC Pavement: Hot-mixed asphalt cement concrete (HMAC) pavement shall be Type D, as specified in SECTION: BITUMINOUS COURSES FOR PAVEMENTS (CENTRAL PLANT HOT-MIX). 50 blow Marshall mix shall be used on Roadway pavements, and 75 blow Marshall mix shall be used on Airfield pavements.

7.2 Bituminous Prime: Bituminous prime shall be a cutback asphalt as specified in SECTION: BITUMINOUS PRIME COAT.

7.3 Bituminous Tack Coat: Bituminous tack coat shall be an asphalt emulsion as specified in SECTION: BITUMINOUS TACK COAT.

7.4 Graded-Crushed-Aggregate Base Course: Graded-crushed-aggregate base course material shall be a well graded crushed aggregate as specified in SECTION: GRADED-CRUSHED-AGGREGATE BASE COURSE.

7.5 Flowable Fill: Flowable fill material shall be a mixture of sand, water, cement and fly ash as specified in SECTION: CONCRETE, GENERAL REQUIREMENTS.

7.6 Fly Ash: Fly Ash material shall be a by product of coal burning as specified in SECTION: ASPHALT PAVEMENT RECYCLING USING CLASS "C" FLY ASH.

PART 3 - EXECUTION

8. PREPARATION FOR PATCHING PAVEMENTS:

8.1 Patching Between Existing Roadway Pavement and New Curb and Gutter: When new concrete curb and gutter is placed adjacent to existing asphalt pavement, curb and gutter forms shall be stripped, curing compound applied and the curb shall be allowed to cure for a minimum of 7 days prior to beginning patching operations.

8.2 Patching of Potholes and Edge Raveling: Potholes and edge raveling requiring patching will be identified by the Government, with the approximate boundary of the patch indicated by painted markings. Up-side-down spray paint for this purpose shall be provided by the contractor, at no additional cost to the Government. The perimeter of each hole or raveled area shall be sawed to form a vertical face and back to well compacted material. Failed material shall be excavated to a depth that provides

a uniform well compacted bottom surface. All loose material resulting from sawing or otherwise existing in the hole shall be removed. Noticeably soft or failed areas of base or subgrade courses shall be excavated or recompact to provide a solid foundation for subsequent pavement courses. If areas to be repaired are wet, provisions shall be made for drying before repair is started. The pot hole shall be dry prior to placing any patching materials. Horizontal surfaces shall be prime coated. Vertical surfaces shall be tack coated. If flowable fill is used, horizontal surfaces shall be tack coated. The contractor shall not mix ionic and cationic emulsions together. Applications shall be exclusively ionic or cationic or cutback.

8.3 Patching of Alligator-Cracked and Rutted Areas: Alligator-cracked and rutted areas requiring patching will be identified by the Government, with the approximate boundary of the patch indicated by painted markings. Up-side-down spray paint for this purpose shall be provided by the contractor, at no additional cost to the Government. The pavement shall be sawed to form a smooth vertical face located 1 foot outside the alligator-cracked or rutted area. The repaired area shall be rectangular in shape with two faces at right angles to the direction of traffic. Unsatisfactory material shall be excavated in a manner not to disturb the sides of the excavated area. Sides of the excavated area shall be vertical, and the bottom of the area shall form a plane parallel with the adjacent pavement surface. Unsatisfactory material shall be removed to the depth that ensures well compacted surfaces for placing new patching material. Noticeably soft or failed base course or subgrade courses shall be excavated or recompact to ensure a solid foundation for subsequent pavement courses. Holes shall be dry prior to placing any patching materials. Horizontal surfaces shall be prime coated. Vertical surfaces shall be tack coated. If flowable fill is used, horizontal surfaces shall be tack coated. The contractor shall not mix ionic and cationic emulsions together. Applications shall be exclusively ionic or cationic or cutback.

9. PREPARATION OF UNDERLYING MATERIALS: Graded-crushed-aggregate base course material shall be placed where unsatisfactory subgrade materials have been removed, or if necessary to ensure a stable subgrade, the contractor shall incorporate graded-crushed-aggregate base course material into soft or failed areas of subgrade as required. Existing failed base course material may also be scarified, fly ash stabilized and recompact depending on the condition of the base course and the size of the contemplated patch. When new concrete curb and gutter or valley gutter is installed adjacent to existing roadway pavement to remain, and cannot be placed directly against a sawed vertical face in the existing pavement, flowable fill material shall be used to fill the space left by the forms between the pavement and the curb and gutter as shown on the details. After placing, each layer shall be compacted by mechanical compactors to a density of not less than the density of the corresponding layer of the adjacent sound pavement structure. When directed for reasons of expediency or patch size, the contractor shall make repairs to failed existing subgrade/base course using flowable fill material. Flowable fill material shall be placed where unsatisfactory subgrade materials have been removed to form a stable substrate for installation of HMAC surface course. Use of flowable fill as a patching material may

be approved as an alternative to patching with graded-crushed-aggregate base course material on a per case basis. The elevation of the surface of the graded-crushed-aggregate base course, or flowable fill shall match the adjoining base course surface or two inches below the surrounding grade whichever is lower.

10. PLACING HOT-MIXED ASPHALT CEMENT (HMAC) PAVEMENT:

10.1 General: Hot-mixed asphalt cement pavement shall be discharged from the mixer at 265 to 323 degrees F. Hot-mixed asphaltic concrete shall be placed at temperature of not less than 245 degrees F and compacted while the material is hot. The material shall be placed in layers not exceeding 2-1/2 inches in thickness and compacted to a 2 inch minimum thickness, at the density specified.

10.2 Pavement Repairs: HMAC material shall be placed, in the area to be patched, in a manner satisfactory to the Contracting Officer. Where material is placed with hand shovels, it shall initially be placed against existing edges and then proceed to the center of the area to be patched. Raking of the material shall be limited to the minimum necessary to level the surface to grade. Compaction of patches shall begin at the edges of the patch and work toward the center. HMAC material shall be placed in successive lifts to match the thickness of the HMAC being repaired as necessary. After completing compaction of the surface layer, a straight edge shall be used to determine conformance with adjacent pavement surface, and any irregularities greater than 1/4 inch in 10 feet shall be corrected.

10.3 Bituminous Prime Coat: Base course of patch areas shall be primed with the specified asphalt emulsion, at a rate of 0.20 to 0.30 gal per square yard. Care shall be taken to apply no more asphalt than will penetrate into the base course during curing. Excess prime shall be blotted with sand before the surfacing material is applied. The application temperature of prime material shall be at least 85 degrees F.

10.4 Bituminous Tack Coat: Vertical faces at edges of existing asphaltic concrete or Portland cement concrete that will come in contact with new asphalt pavement shall be given a tack coat of the specified asphalt emulsion diluted 50/50 with water applied at a rate of 0.06 to 0.08 gal per square yard. After application of the tack coat, time shall be allowed for the material to cure before patching material is placed. Application temperature of tack coat shall be 70 to 160 degrees F.

11. DEGREES OF COMPACTION:

11.1 Subgrade: Due to the varying locations and varying properties of subgrade likely to be encountered, no laboratory maximum density determination will be required for subgrade soils.

11.2 Graded-Crushed-Aggregate Base Course: Degree of compaction shall be as required in SECTION: GRADED-CRUSHED-AGGREGATE BASE COURSE.

11.3 Hot-Mixed Asphalt Cement (HMAC) Pavement: Degree of compaction shall be as required in SECTION: BITUMINOUS COURSES FOR PAVEMENTS (CENTRAL PLANT HOT-MIX).

12. IN-PLACE FIELD DENSITY:

12.1 Subgrade: In-place density of subgrade shall be evaluated visually by both the contractor and the Government inspector. The contractor shall notify the Government inspector when the subgrade course is ready for inspection and no graded-crushed-aggregate base course material or flowable fill material shall be placed until the subgrade course is approved. Reapproval of subgrade is required if rain occurs after initial approval is obtained.

12.2 Graded-Crushed-Aggregate Base Course: In-place field density and frequency of testing for graded-crushed-aggregate base course shall as specified in SECTION: GRADED-CRUSHED-AGGREGATE BASE COURSE and SECTION: CONTRACTOR QUALITY CONTROL.

12.3 Hot-Mixed Asphalt Cement (HMAC) Pavement: In-place density and frequency of testing for hot-mixed asphalt cement (HMAC) pavement shall be as specified in SECTION: BITUMINOUS COURSES FOR PAVEMENTS (CENTRAL PLANT HOT-MIX) and SECTION: CONTRACTOR QUALITY CONTROL.

13. TRAFFIC CONTROL: Vehicular or aircraft traffic shall not be permitted over patches until the patching material has cured sufficiently to become stable enough that rutting will not occur. The contractor shall erect suitable barriers, as determined by the Contracting Officer and as specified herein to control vehicular and aircraft traffic.

SECTION 2I

JOINT AND CRACK SAWING, SEALING AND RESEALING IN PAVEMENTS

PART 1 - GENERAL

1. APPLICABLE PUBLICATIONS: The standard listed below forms a part of this specification to the extent referenced. The publications are referred to in the test by the basic designations only.

1.1 Federal Specification (Fed. Spec.):

SS-S-1401C	14 May 93, 13 Mar 68, 15 Aug 84	Sealant, Joint, Non-Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Asphalt Concrete Pavements.
SS-S-1614A	14 May 93, 15 Aug 84, 05 Sep 88	Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements

1.2 American Society for Testing and Materials (ASTM) Publications:

C 719-93	1993	Adhesion and Cohesion of Elastomeric Joint Sealant Under Cyclic Movement (Hockman Cycle)
D 412-92	1992	Standard Methods of Testing Joint Sealant, Hot-Applied, Elastomeric-Type for Portland Cement Concrete Pavements, or Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel Resistant-Type for Portland Cement Concrete Pavements (R1991) (Withdrawn)
D 3583-85	1985	Standard Test methods for Vulcanized Rubber and ThermoPlastic Elastomers-

Tension

2. EQUIPMENT: Machines, tools, and equipment used in the performance of the work required by this section will be approved by the Contracting Officer before the work is started and shall be maintained in satisfactory condition.

2.1 Joint and Crack Cleaning, Sawing, and Sealing Equipment:

2.1.1 Tractor-Mounted Routing Tool: Routing tool for removing old sealant from joints in concrete pavements shall be of such shape and dimension and so mounted on the tractor that it will plow out old sealant material and not damage the sides of the joints and can be adjusted to remove the old material to varying depths as specified by the Contracting Officer. The use of V-shaped tools or rotary impact routing devices will not be permitted for routing joints.

2.1.2 Crack Routing Tool: Routing tool for widening, deepening, and establishing a sealant reservoir in cracks that have not been sealed, and for removing old sealant from cracks that have been sealed in concrete and asphalt pavements shall be of the vertical spindle type. Routing tool shall be equipped with a bit of such size so as to produce a sealant reservoir of required size. Machines using a horizontal spindle, rotary impact or similar methods are prohibited.

2.1.3 Concrete Saw(s): A self-propelled, water cooled, power saw with diamond or abrasive blades shall be provided for sawing new joints and refacing existing joints in concrete pavements where surface films of old joint sealant cannot be removed by sandblasting methods. A power saw with diamond or abrasive blades shall be provided for cutting the joint sealant reservoir between asphalt pavement and curb and gutter and valley gutter shown in Detail "A" to the specified widths and depths.

2.1.4 Sandblasting Equipment: Sandblasting equipment shall include an air compressor, hose, venturi-type nozzles of sufficient capacity to furnish air at a rate of not less than 150 CFM and to maintain a line pressure of not less than 90 PSI at the nozzle while in use. The compressor shall be equipped with traps that maintain the compressed air free of oil and water.

2.1.5 Air Blasting Equipment: Air blasting equipment shall include an air compressor, hose, venturi-type nozzle of sufficient capacity to furnish air at a rate of not less than 100 CFM and to maintain a line pressure of not less than 70 PSI at the nozzle while in use. The compressor shall be equipped with traps that maintain the compressed air free of oil and water.

2.1.6 Hot-Poured Sealant Equipment: The unit applicators used for heating and installing hot-poured sealant materials shall be mobile, and shall be equipped with a double-boiler agitator-type kettle with an oil medium in the outer space for heat transfer, a direct-connected pressure-type extruding device connected to a trigger activated wand with nozzle for filling joints and cracks. The nozzle shall be shaped to fit within the sealant reservoir to permit filling from the bottom up. The unit applicator shall have a positive thermostatically controlled heating device for maintaining the temperature of

the sealant at the temperature recommended by the manufacturer. The applicator unit shall be so designed that the sealant circulates through the delivery hose and returns to the inner kettle when not sealing joints.

2.1.7 Separating Media (Backer Rod) Installation Equipment: Backer rod installation equipment shall consist of a wheel designed to force backer rod into the prepared sealant reservoir at the proper depth, without stretching the backer rod. The wheel shall be equipped with adjustable shims or shoulders on either side to limit the depth the wheel will enter the sealant reservoir, and thus the backer rod depth, when rolled over the joint, or crack.

2.1.8 Silicone Sealant Equipment: Pumping equipment shall include an air compressor, hose extrusion pump and follower plate. The air compressor shall be capable of provide air at a minimum rate of 60 CFM at 100 PSI pressure. Air compressor shall be equipped with traps that maintain the air free of oil and water. A pump ratio of 35:1 or greater shall be provided. Teflon line hoses are mandatory. Pump and hose seals shall be fabricated of Teflon. Hose diameter shall be not less than 3/4 inch. Pumps shall be designed so as to prevent introduction of air into the product being pumped. Hose wands shall be equipped with extrusion nozzles or a size appropriate for the joint being sealed.

3. SUBMITTALS: Prior to ordering joint or crack sealant materials for use on roadway pavements or silicone sealants for use on airfield pavements, 4 certified copies of test reports demonstrating compliance with the applicable specification shall be submitted and approved. Test reports need not be performed for this specific job, but shall be a maximum of one year old. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the materials, printed copies of these recommendations shall be furnished prior to use on the project. Installation of the material shall not be allowed until the recommendations are received. Joint sealant for use on roadway pavements and silicone sealants for use on airfield pavements will be accepted or rejected on the basis of test reports furnished.

4. TESTING: Hot-poured joint and crack sealant for use on airfield pavements will be accepted or rejected on the basis of tests conducted by the Government on the sealant proposed for use. When joint or crack sealing/resealing on airfield pavement is specified, the contractor will be required to provide, at no additional cost to the Government, at least the equivalent of one 5 gallon container of sealant material for testing purposes. All fees for initial testing, including shipping, will be paid for by the Government. Should the sealant proposed for use fail to meet the requirements of the specifications, the contractor shall bear any and all expenses associated with retesting. Testing must be performed by a Government owned laboratory. Samples shall be provided as required in SECTION: CONTRACTOR QUALITY CONTROL.

5. DELIVERY AND STORAGE: Materials delivered to the site shall be inspected for damage, unloaded and stored with a minimum of handling. Materials

shall be handled in such a manner as to insure no damage to the joint sealant materials. Storage facilities shall be provided by the contractor at the jobsite for maintaining materials at temperatures recommended by the manufacturer.

6. MEASUREMENT:

6.1 Forming Expansion Joints in Concrete Pavements: The quantity of forming expansion joints in concrete pavements to be paid for will be the negotiated number of linear feet of forming expansion joints in concrete pavements, as stated in the Task Order.

6.2 Sawing and Sealing Joints in Concrete Pavements: The quantity of sawing and sealing of joints in concrete pavements to be paid for will be the negotiated number of linear feet of sawing and sealing joints in concrete pavements, as stated in the Task Order.

6.3 Forming and Sealing Expansion Joints in Concrete Pavements: The quantity of forming and sealing of expansion joints in concrete pavements to be paid for will be the negotiated number of linear feet of forming and sealing expansion joints in concrete pavements, as stated in the Task Order.

6.4 Cleaning and Resealing Joints in Concrete Pavements: The quantity of cleaning and resealing of joints in concrete pavements to be paid for will be the negotiated number of linear feet of cleaning and resealing joints in concrete pavements, as stated in the Task Order. No consideration will be given to existing joint width.

6.5 Cleaning and Resealing Random Cracks in Concrete Pavements: The quantity of cleaning and resealing of random cracks in concrete pavements to be paid for will be the negotiated number of linear feet cleaning and resealing random cracks in concrete pavements, as stated in the Task Order. No consideration will be given to existing crack width.

6.6 Routing and Sealing Random Cracks in Concrete Pavements: The quantity of routing and sealing of random cracks in concrete pavements to be paid for will be the negotiated number of linear feet of routing and sealing random cracks in concrete pavements, as stated in the Task Order. No consideration will be given to existing crack width.

6.7 Cleaning and Resealing Random Cracks in Asphalt Pavements: This bid item, will be required and applied only when the cracks being resealed have been previously routed and old sealant materials must be removed. Cracks that have been sealed in the past but no routing was accomplished will be treated as sealing cracks not resealing cracks. The quantity of cleaning and resealing of random cracks in asphalt pavements to be paid for will be the negotiated number of linear feet of cleaning and resealing random cracks in asphalt pavements, as stated in the Task Order. No consideration will be given to existing crack width.

6.8 Cleaning and Sealing Random Cracks in Asphalt Pavements (Cracks \leq 1/16" in width): The quantity of cleaning and sealing of random cracks in asphalt pavements (cracks \leq 1/16" in width) to be paid for will be the negotiated number of linear feet of cleaning and sealing random cracks in asphalt pavements (cracks \leq 1/16" in width), as stated in the Task Order.

6.9 Routing and Sealing Random Cracks in Asphalt Pavements (Cracks $>$ 1/16" in Width): The quantity of routing and sealing of random cracks in asphalt pavements (cracks $>$ 1/16" in width) to be paid for will be the negotiated number of linear feet of routing and sealing of random cracks in asphalt pavements (cracks $>$ 1/16" in width), as stated in the Task Order.

6.10 Sawing and Sealing Detail "A" in Asphalt Pavements: The quantity of sawing and sealing of Detail "A", between asphalt pavements and curb and gutter, valley gutter, or concrete pavements to be paid for will be the negotiated number of linear feet of sawing and sealing of Detail "A", as stated in the Task Order.

7. BASIS FOR PAYMENT:

7.1 Forming Expansion Joints in Concrete Pavements: Payment for the quantities of forming expansion joints in concrete pavements, Detail "D", determined as specified above will be made at the contract unit price per linear foot, as established in the bid schedule for Roadway work. Such payment shall constitute full compensation for all labor, materials, expansion joint filler, backer rod, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

7.2 Sawing and Sealing Joints in Concrete Pavements: Payment for the quantities of sawing and sealing joints in concrete pavements determined as specified above will be made at the appropriate contract unit price per linear foot, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for all labor, materials, backer rod, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

7.3 Forming and Sealing Expansion Joints in Concrete Pavements: Payment for the quantities of forming and sealing expansion joints in concrete pavements, including forming and sealing Detail "B" between concrete pavements and concrete curb and gutter or concrete valley gutter, and forming and sealing Detail "C" between concrete curb and gutter and concrete sidewalk, determined as specified above will be made at the appropriate contract unit price per linear foot, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for all labor, materials, backer rod if required, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

7.4 Cleaning and Resealing Joints in Concrete Pavements: Payment for the quantities of cleaning and resealing joints in concrete pavements determined as specified above will be made at the appropriate contract unit price per linear foot, as established in the bid schedule for Airfield or Roadway work. Such payment shall

constitute full compensation for all labor, materials, backer rod, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

7.5 Cleaning and Resealing Random Cracks in Concrete Pavements: Payment for the quantities of cleaning and resealing random cracks in concrete pavements determined as specified above will be made at the appropriate contract unit price per linear foot, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for all labor, materials, backer rod, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

7.6 Routing and Sealing Random Cracks in Concrete Pavements: Payment for the quantities of routing and sealing random cracks in concrete pavements determined as specified above will be made at the appropriate contract unit price per linear foot, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for all labor, materials, backer rod, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

7.7 Cleaning and Resealing Random Cracks in Asphalt Pavements: Payment for the quantities of cleaning and resealing random cracks in asphalt pavements determined as specified above will be made at the appropriate contract unit price per linear foot, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for all labor, materials, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

7.8 Cleaning and Sealing Random Cracks in Asphalt Pavements (Cracks \leq 1/16" in Width): Payment for the quantities of cleaning and sealing random cracks (cracks \leq 1/16" in width) in asphalt pavements determined as specified above will be made at the appropriate contract unit price per linear foot, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for all labor, materials, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

7.9 Routing and Sealing Random Cracks in Asphalt Pavements (Cracks $>$ 1/16" in Width): Payment for the quantities of routing and sealing random cracks in asphalt pavements (cracks $>$ 1/16" in width) determined as specified above will be made at the appropriate contract unit price per linear foot, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for all labor, materials, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

7.10 Sawing and Sealing Detail "A" in Asphalt Pavements: Payment for the quantities of sawing and sealing Detail "A" in asphalt pavements, determined as specified above will be made at the contract unit price per linear foot, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for all labor, materials, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

PART 2 - PRODUCTS

8. SEALANTS shall conform to the following requirements:

8.1 Sealant Material:

8.1.1 Jet-Fuel-Resistant Sealant Material: Jet-Fuel-Resistant sealant material shall conform with Fed. Spec. SS-S-1614.

8.1.2 Non-Jet-Fuel Resistant Sealant Material: Non-Jet-Fuel Resistant sealant material shall conform with Fed. Spec. SS-S-1401.

8.1.3 Silicone Sealant Material: Silicone sealant material shall be a one-part self-leveling silicone material that cures to an ultra-low-modulus silicone rubber upon exposure to atmospheric moisture which is specifically intended to seal/reseal expansion, contraction, and/or construction joints in pavements. Silicone sealant material shall have the following properties.

a. A minimum percent elongation of 1400 when tested in accordance with ASTM D 412.

b. A maximum joint modulus of 9 PSI at 150 percent elongation when tested in accordance with ASTM D 3583.

c. A joint movement capacity of + 100 to -50% through 10 cycles with no failure when tested in accordance with ASTM C 719.

d. No loss of adhesion to concrete with a minimum of + 600% elongation when tested in accordance with ASTM D 3583.

Product Dow Corning 890-SL as manufactured the Dow Corning Corporation, Midland, Michigan meets the requirements of this specification.

9. PRIMERS: The use of primers when recommended by the manufacturer of the proposed sealant is required, at no additional cost to the Government, in accordance with the manufacturer's instructions.

10. SEPARATING MEDIA (BACKER ROD): The separating media (backer rod) used to seal off the lower portion of joints shall be a readily compressible, non-shrinkable, non-absorptive, cylindrical shaped, foam rubber or plastic rope backer rod. Such backer rod shall be non-reactive with the sealant proposed for use and shall not soften or melt at the pouring temperature of the sealant being used. The contractor shall provide backer rod of the proper diameter for installation in joints of various widths.

11. SEALANT USAGE:

11.1 Sealing Concrete Airfield Pavements: Either Fed. Spec. SS-S-1401, Fed. Spec. SS-S-1614, or Silicone sealant as specified.

11.2 Sealing Asphalt Airfield Pavements: Fed. Spec. SS-S-1401 sealant material.

11.3 Sealing Detail "A" in Asphalt Pavements: Fed. Spec. SS-S-1401 sealant material.

11.4 Sealing Detail "B" in Concrete Pavements: Fed. Spec. SS-S-1401 sealant material.

11.5 Sealing Detail "C" Between Concrete Curb and Gutter and Concrete Sidewalk: Fed. Spec. SS-S-1401 sealant material.

11.6 Sealing Concrete Roadway Pavements: Fed. Spec. SS-S-1401 sealant material.

11.7 Sealing Asphalt Roadway Pavements: Fed. Spec. SS-S-1401 sealant material.

PART 3 - EXECUTION

12. SAWING JOINTS IN CONCRETE PAVEMENTS: Contraction joints shall be located as directed or as shown in the drawings. Contraction joints shall be constructed as shown in the details. Initially, 1/8 inch wide cuts, 1/4 the pavement thickness, shall be sawed when the concrete has cured sufficiently to hold aggregate without raveling or the aggregate pulling out of the concrete mass while sawing. Later, the joint sealant reservoir shall be chased out over the 1/8 inch cuts to provide the proper joint sealant shape factor.

13. PREPARATION OF JOINTS AND CRACKS: Joints and cracks shall be prepared for sealing and resealing as follows:

13.1 Sawing and Sealing Joints in New Concrete Pavements: After the joint sealant reservoir has been sawed as specified above, the contractor shall sandblast the exposed faces of the joint to provide a rough surface for sealant material to adhere to. Next, and immediately prior to installing the backer rod material, the joint shall be thoroughly blown out with airblasting equipment and cleaned of all sand, and debris and made ready for the placement of backer rod material.

13.2 Forming and Sealing Expansion Joints in Concrete Pavements: After the concrete has been placed on either side of the joint, the top portion of the expansion joint filler material shall be removed to form a sealant reservoir. Next, and immediately prior to sealing, the joint shall be thoroughly blown out with airblasting equipment and cleaned of all sand, and debris and made ready for sealing. Installation of backer rod will be required only when sealing expansion joints in airfield pavements. Backer rod will not be required when sealing expansion joints in concrete roadway pavements or when sealing Detail "B" or Detail "C".

13.3 Cleaning and Resealing Joints In Concrete Pavements: The existing joint sealant reservoir shall be plowed to remove the bulk of the old sealant materials, using

the specified tractor-mounted routing equipment. Next, the faces of the joint shall be either sandblast cleaned or refaced with the specified concrete saw and all residual old sealant removed. When silicone sealants are specified, the joints must be refaced with the specified concrete saw and sandblast cleaning is not an option. After refacing is complete, depth shall be verified and the joints shall be deepened if necessary to provide the proper shape. If the joints are refaced using the concrete saw, care shall be taken to ensure that the joints are not widened more than the absolute minimum necessary to remove existing sealant from the joint faces. If directed, and necessary to achieve the proper joint sealant shape factor, the joint sealant reservoir shall be deepened by sawing with the specified concrete saw equipped with a gang arrangement of saw blades. Next, the contractor shall sandblast the exposed faces of the joint to provide a rough surface for sealant material to adhere to. Next, and immediately prior to installing the backer rod material, the joint shall be thoroughly blown out with airblasting equipment and cleaned of all sand, and debris and made ready for the placement of backer rod material.

13.4 Cleaning and Resealing Random Cracks in Concrete Pavements:

Depending on the degree of bend in the crack being resealed, the contractor shall either plow the crack using the specified tractor-mounted routing equipment or rout the crack using the specified vertical spindle routing machine to remove old sealant materials. Next, the faces of the sealant reservoir shall be sandblast cleaned and all residual old sealant removed. If directed, and necessary to achieve the proper sealant shape factor, the existing sealant reservoir of the random crack shall be deepened by routing with the specified vertical spindle router with a bit designed to deepen the cut. Next, the contractor shall sandblast the exposed faces of the crack to provide a rough surface for sealant material to adhere to. Next, and immediately prior to installing the backer rod material, the crack shall be thoroughly blown out with airblasting equipment and cleaned of all sand, and debris and made ready for the placement of backer rod material.

13.5 Routing and Sealing Random Cracks in Concrete Pavements: The contractor shall cut a sealant reservoir of the proper depth and width, using the specified vertical spindle router, to achieve the proper sealant shape factor directly over the crack to be sealed. Next, the faces of the sealant reservoir shall be sandblast cleaned to provide a rough surface for sealant material to adhere to. Next, and immediately prior to installing the backer rod material, the crack shall be thoroughly blown out with airblasting equipment and cleaned of all sand, and debris and made ready for the placement of backer rod material.

13.6 Cleaning and Resealing Random Cracks in Asphalt Pavements: This operation will be required only when the cracks previously sealed were routed, and old sealant materials must be removed. The contractor shall rout the crack using the specified vertical spindle routing machine to remove old sealant materials. Next, and immediately prior to installing the sealant material, the crack shall be thoroughly blown out with airblasting equipment and cleaned of all sand, and debris and made ready for the installation of sealant material. Backer rod material will not be required for sealing

of cracks in asphalt pavements, but to limit wastage of sealant material, it may be installed at the option of the contractor at no additional cost to the Government.

13.7 Cleaning and Sealing Random Cracks in Asphalt Pavements (Cracks \leq 1/16" or Less in Width): Immediately prior to installing the sealant material, the crack shall be thoroughly blown out with airblasting equipment and cleaned of all sand, and debris and made ready for the installation of sealant material. Backer rod material will not be required for sealing of cracks in asphalt pavements, but to limit wastage of sealant material, it may be installed at the option of the contractor at no additional cost to the Government.

13.8 Routing and Sealing Random Cracks in Asphalt Pavements (Cracks $>$ 1/16" in Width): The contractor shall cut a sealant reservoir of the proper depth and width, using the specified vertical spindle router, to achieve the proper sealant shape factor directly over the crack to be sealed. Immediately prior to installing the sealant material, the crack shall be thoroughly blown out with airblasting equipment and cleaned of all sand, and debris and made ready for the installation of sealant material. Backer rod material for sealing of cracks in asphalt pavements may be required depending on crack width and depth.

13.9 Sawing and Sealing Detail "A": After the final asphalt surfacing has been installed adjacent to curb and valley gutter, a sealant reservoir shall be chased out as shown in the details using the specified saw equipped with a gang arrangement of saw blades. Immediately prior to installing the sealant material, the sealant reservoir shall be thoroughly blown out with airblasting equipment and cleaned of all sand, and debris and made ready for the installation of sealant material. Backer rod material will not be required for sealing of Detail "A", but to limit wastage of sealant material, it may be installed at the option of the contractor at no additional cost to the Government. Sealing of Detail "A" may also be required at existing pavements and curbs and valley gutters as determined by the Government, at no change in the unit price.

14. INSTALLATION OF SEPARATING MEDIA (BACKER ROD): Backer rod separating media shall be installed in the lower portion of joints and random cracks in concrete pavements to prevent migration of sealant and to provide the proper width to depth ratio for the sealant reservoir. Backer rod separating media shall be provided of a diameter such that it will fit snugly into the sealant reservoir without undue deformation, but will remain in place and not "float" out when sealant material is installed. Backer rod separating media shall be installed with a roller device used to force the material into the reservoir at the proper depth. Backer rod separating media shall not be stretched or twisted during installation. Splices in material shall be made in accordance with the manufacturer's recommendations.

15. RATE OF PROGRESS: The work required for removal of existing sealant, plowing/routing of joints, refacing, widening or deepening of joints, and cracks may proceed at the rate of progress approved by the Contracting Officer. The stages of joint and crack preparation, which include refacing, sandblasting, air blast cleaning, and

installation of backer material, shall be subject to approval by the Government and shall be conducted in accordance with the manufacturer's written recommendations.

16. PREPARATION OF SEALANT:

16.1 Hot-Applied Sealant: Hot applied sealants shall not be heated in excess of the safe heating temperature recommended by the sealant manufacturer as shown on the sealant containers. Sealant that has been overheated or subjected to heating for over 3 hours or that has remained in the applicator at the end of the day's operations shall be withdrawn and wasted.

16.2 Cold-Applied Sealant: Cold applied sealants shall be protected from freezing and/or exposure to air from delivery to installation.

17. INSTALLATION OF SEALANTS:

17.1 Time of Application: Joints and cracks shall be sealed or resealed immediately following final preparation as specified above or as soon thereafter as weather permits. Walls of the sealant reservoir shall be surface dry, and the atmospheric and pavement temperature shall be above 50 degrees F and rising at the time of application of the sealant. Silicone sealants may be installed when the temperature is 40 degrees F and rising. Open joints and cracks that cannot be sealed or resealed under the conditions specified herein shall be provided with an approved temporary seal to prevent infiltration of foreign particles. Wet joints, and cracks shall be dried prior to installing sealants.

17.2 Sealing Routed and Sawn Joints and Cracks in Asphalt and Concrete Pavement: No joint sealant material shall be installed until the cleaned joints and cracks have been inspected and approved. After the backer rod separating media, if required, has been installed and approved, cracks and joints shall be filled from the bottom up to within $1/8$ inch \pm $1/16$ inch of the surface of the pavement for hot-poured sealants and according to the manufacturer's recommendations for silicone sealants.. Equipment specified in paragraph EQUIPMENT shall be used. Excess or spilled sealant shall be removed from the pavement and discarded. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. In no case shall sealant be installed using the gravity method and pouring pots. When a primer is supplied by the manufacturer, it shall be applied evenly to the sealant reservoir faces in accordance with the manufacturer's recommendations. Joints and cracks shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within the manufacturer's recommended curing time. The contractor shall erect barricades, as required and approved by the Contracting Officer, or as specified herein as appropriate, to protect sealant during the curing time, and shall be responsible for sealant displaced by foot, vehicle, or aircraft traffic as a result of lack of barricades.

17.3 Sealing Unrouted Cracks in Asphalt Pavements: No joint sealant material shall be installed until the cleaned cracks have been inspected and approved. Cracks

shall be filled up flush with the surface of the pavement. Equipment specified in paragraph EQUIPMENT shall be used. After the sealant material has been placed over the crack to be sealed, it shall be forced into the crack using a rubber squeegee. Rubber squeegee shall be either separate or attached to the delivery wand. Excess or spilled sealant shall be removed from the pavement and discarded. Traffic shall not be permitted over newly sealed pavement until authorized by the Contracting Officer. In no case shall sealant be installed using the gravity method and pouring pots. Cracks shall be checked frequently to ensure that the newly installed sealant is cured to a tack-free condition within the manufacturer's recommended curing time. The contractor shall erect barricades, as required and approved by the Contracting Officer, or as specified herein as appropriate, to protect sealant during the curing time, and shall be responsible for sealant displaced by foot, vehicle, or aircraft traffic as a result of lack of barricades.

18. INSPECTIONS:

18.1 Joint and Crack Inspection: Joints and cracks shall be inspected during cleaning to correct improper equipment and cleaning techniques that damage the pavement, widen, or increase the V-shaped cross section of joints and cracks and ravel asphalt or spall concrete pavement. Cleaned joints and cracks shall be approved prior to installing joint sealant material.

18.2 Sealing Operations: Application equipment shall be inspected to assure conformance to temperature requirements, and installation. Evidence of improper installation shall be cause to suspend operations until causes of deficiencies are determined and corrected.

18.3 Sealant Inspection: Sealant shall be inspected for proper rate of cure and set, bonding to concrete surfaces of the sealant reservoir walls, and entrapped air and voids. Sealants exhibiting any deficiencies will be rejected. Sealants may be rejected at any time prior to final acceptance of the project. Sealant that is rejected shall be removed from the sealant reservoir, wasted, and replaced at no additional cost to the Government.

18.4 Manufacturer's Inspection: At the beginning of each Task Order where silicone sealants are specified, a representative from the manufacturer shall be present at the beginning of the work to observe the preparation of the joints and cracks and installation procedures being employed. This inspection shall be used to identify and correct any procedures which may be detrimental to the finished product. The manufacturer's written recommendations shall be followed regardless of conflict with this specification as written at no additional cost to the Government.

SECTION 2J

BITUMINOUS SURFACE TREATMENT

PART 1 - GENERAL

1. APPLICABLE PUBLICATIONS: The American Society for Testing and Materials (ASTM) Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designations only.

C 29/C29M Rev A-91	1991	Standard Test Method for Unit Weight and Voids in Aggregate
C 88-90	1990	Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 131-89	1989	Test Method for Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
C 136-96	1996	Method for Sieve Analysis of Fine and Coarse Aggregates
D 75-87	(R 1992)	Sampling Aggregates
D 140-93	1993	Sampling Bituminous Materials
D 977-91	1991	Emulsified Asphalt
D 2397-94	1994	Cationic Emulsified Asphalt

2. EQUIPMENT, TOOLS, AND MACHINES:

2.1 Bituminous Distributors: The distributors shall have pneumatic tires of such width and number that the load produced on the pavement surface does not exceed 650 pounds per inch of tire width. Distributors shall be designed and equipped to distribute bituminous material uniformly at even heat on various widths of surface, at readily determined and controlled rates ranging from 0.05 to 2.00 gallons per square yard, with a pressure range of 25 to 75 PSI. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gages, volume-measuring devices, a thermometer for reading the temperature of tank contents, and a hose attachment suitable for applying bituminous material to

areas not accessible with distributor spray bar. The distributor shall be equipped for circulation and agitation of bituminous material during the heating process.

2.2 Single-Pass, Surface-Treatment Machines: The machines shall be capable of spraying bituminous material and spreading aggregate in one pass. Bituminous spraying equipment shall conform to the requirements given above for a bituminous distributor. The machine shall be capable of spreading aggregates at controlled amounts per square yard as specified. In addition, the single-pass, surface-treatment machine shall be capable of placing a surface treatment adjacent to an existing surface treatment, forming a joint of the same thickness and uniformity of other portions of the surface treatment. Ridges or blank spaces will not be permitted.

2.3 Spreader Box: The machine shall be capable of spreading aggregate onto previously applied emulsion in one pass while running on the surface of aggregate applied immediately ahead of the wheels. The machine shall be capable of spreading aggregates at controlled amounts per square yard as specified. In addition, spreader box shall be capable of placing aggregate adjacent to an existing surface treatment, forming a joint of the same thickness and uniformity of other portions of the surface treatment. Ridges or blank spaces will not be permitted.

2.4 Heating Equipment for Storage Tanks: The equipment shall consist of coils and equipment for producing steam or hot oil and be designed to prevent the introduction of steam or hot oil into the material. An armored thermometer with a range of 100 to 400 degrees F shall be affixed to the tank so the temperature of the bituminous material may be determined at all times.

2.5 Power Rollers: Power rollers shall be pneumatic-tired type, conforming to the following requirements:

2.5.1 Pneumatic-tired rollers shall be self-propelled and have wheels mounted on two axles in such a manner that the rear tires will not follow in the tracks of the forward group. Tires shall be uniformly inflated to not less than 40 PSI nor more than 60 PSI pressure. The pneumatic-tired rollers shall be equipped with boxes or platforms for ballast loading and shall be loaded so that the tire print width of each wheel is not less than the least distance between tire prints.

2.6 Brooms and Blowers: The machines shall be of the power type, capable of cleaning surfaces to be treated.

3. SAMPLING AND TESTING: The sampling and testing shall be the responsibility of the contractor. Sampling and testing shall be performed by a Government approved commercial testing laboratory, regularly engaged in such testing. Sampling shall be in accordance with ASTM D 75 for aggregates and ASTM D 140 for bituminous material, unless otherwise directed. Tests shall be performed in sufficient number to insure that materials meet specified requirements. Copies of test results shall be furnished to the Contracting Officer within 24 hours after completion of each

test. No materials shall be used on the job until approval is obtained from the Contracting Officer.

3.1 Stripping Test: A test sample consisting of the aggregate and bitumen to be used shall meet the requirements of ASTM D 1664. One test shall be performed prior to placing any materials.

3.2 Wear Test: The wear test shall be performed in accordance with ASTM C 131 to insure that aggregates have a percentage of wear not exceeding 40 percent after 500 revolutions. One test shall be performed prior to placing any materials.

3.3 Soundness Test: The soundness test shall be performed as specified by ASTM C 88 to insure that aggregates have a weight loss not greater than 15 percent when subjected to five cycles of the magnesium sulfate test. One test shall be performed prior to placing any materials.

3.4 Application Rate Tests: The contractor shall construct two sheet metal pans with turned up edges for application rate tests. The metal pans shall be 3 feet on each edge to exhibit one square yard of surface area when laid on the pavement surface. The contractor shall use the pans to calibrate the application rates of both the bituminous material and the aggregate material by placing the pans on the pavement surface, passing his bituminous surface treatment equipment over the pans and weighing the material applied in the pans. The contractor shall provide scales to weigh the materials and shall tare the pans prior to weighing the material. The contractor shall provide the Government with the specific gravity of the asphalt emulsion in order to convert weight to volume. All calibration and weighing shall be performed in the presence of the Government inspector. A designated test strip area will be provided to the contractor for calibration of equipment at the job site. The contractor shall repair, to the satisfaction of the Contracting Officer, any areas receiving improper application as a result of calibration efforts. Application shall not proceed until, in the opinion of the Government inspector, calibration is complete.

4. WEATHER LIMITATIONS: Bituminous surface treatment shall be applied only when the existing pavement surface is dry. Bituminous surface treatment shall not be applied when either the atmospheric temperature, in the shade, is below 50 degrees F, or the pavement surface to be treated is below 70 degrees F, unless otherwise directed. The contractor shall verify the temperature each day with Base Weather, through Civil Engineering Contracts Section prior to placing materials.

5. WAYBILLS AND DELIVERY TICKETS: Copies of waybills and delivery tickets shall be submitted in accordance with SECTION: PROJECT SUBMITTALS. Before the final statement is allowed, the contractor shall file with the Contracting Officer certified waybills and delivery tickets for aggregate and bituminous material used in the bituminous surface treatment. The contractor shall not remove bituminous material from the tank car or storage tank until initial outage and temperature has been taken; nor shall the car or tank be released until final outage has been taken. Since payment for the quantities of aggregate and bituminous materials used in completion of

the work will be made as a part of the unit priced bid items for Butuminous Surface Treatment and Fog Seal where payment will be made at the quantity negotiated and contained in each Task Order, submission of waybills and delivery tickets is not required.

6. MEASUREMENT:

6.1 Bituminous Surface Treatment: The quantity of bituminous surface treatment to be paid for will be the negotiated number of square yards of bituminous surface treatment, as stated in the Task Order.

6.2 Bituminous Fog Seal: The quantity of bituminous fog seal to be paid for will be the negotiated number of square yards of bituminous fog seal, as stated in the Task Order.

6.3 Installation of Prime Coat: If prime coat is necessary, as determined by the Government, over stabilized aggregate bases or recycled pavement, measurement of prime coat installation will be made in accordance with the measurement clause "Bituminous Prime Coat" contained in SECTION: BITUMINOUS PRIME COAT.

7. BASIS FOR PAYMENT:

7.1 Bituminous Surface Treatment: Payment for the quantity of bituminous surface treatment determined as specified above, will be made at the appropriate contract unit price, per square yard, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for furnishing all labor, equipment, testing, materials, supervision, overhead, profit, and incidentals necessary to complete the work.

7.2 Bituminous Fog Seal: Payment for the quantity of bituminous fog seal determined as specified above, will be made at the appropriate contract unit price, per square yard, as established in the bid schedule for Airfield or Roadway work. Such payment shall constitute full compensation for furnishing all labor, equipment, testing, materials, supervision, overhead, profit, and incidentals necessary to complete the work.

7.3 Installation of Prime Coat: Payment for the quantity of prime coat installation determined as specified above will be made in accordance with the payment clause "Bituminous Prime Coat" contained in SECTION: BITUMINOUS PRIME COAT.

PART 2 - PRODUCTS

8. MATERIALS: Mineral aggregate and bituminous material of the following types, gradations, grades, and consistencies and meeting the requirements of stripping, wear and soundness tests as specified in paragraph SAMPLING AND TESTING shall be used.

8.1 Mineral Aggregate: The aggregate shall consist of crushed stone, or crushed gravel, and shall be of such nature that thorough coating of bituminous

material used in the work will not strip off upon contact with water. Moisture content of the aggregate shall be such that the aggregate will be readily coated with the bituminous material. Drying may be required, as directed. Aggregate shall conform to the gradation shown below. Gradation of the aggregates shall be determined by ASTM D 136. Unit weight per cubic foot shall be determined by ASTM C 29, unit weight shall be in the loose, uncompacted state.

AGGREGATE GRADATION
SINGLE BITUMINOUS SURFACE TREATMENT
(PERCENT BY WEIGHT PASSING)

Sieve Designation	No. 1
1-inch	---
3/4-inch	100
1/2-inch	90-100
3/8-inch	40-70
No. 4	0-15
No. 8	0-5
No. 16	---

8.1.1 Crushed stone shall consist of clean, sound, durable particles, free of soft or disintegrated pieces, dust, or foreign matter.

8.1.2 Crushed gravel shall consist of clean, sound, durable particles, free of soft or disintegrated pieces or foreign matter. At least 90 percent by weight of the particles shall have at least two fractured faces.

8.2 Bituminous Materials:

8.2.1 Bituminous Materials For Bituminous Surface Treatment: The bituminous material shall be emulsions conforming to ASTM D 977 or D 2397, Grade RS-2 or CRS-2 respectively.

8.2.2 Bituminous Materials For Fog Seal: The bituminous materials shall be emulsions conforming to ASTM D 977 or D 2397, Grade SS-1 or CSS-1 respectively.

8.2.3 Prime Coat: Prime coat shall be a cutback asphalt material conforming to SECTION: PRIME COAT.

PART 3 - EXECUTION

9. QUANTITIES OF MATERIALS PER SQUARE YARD: The bituminous material and aggregate shall be spread within the quantity limits shown below.

QUANTITIES (PER SQUARE YARD)[FOR SINGLE SURFACE TREATMENT]		
Gradation No.	Bituminous Material (Gallons)	Aggregate(Pounds)
1	0.42 ± 1% *	23.4 ± 5% *
QUANTITIES (PER SQUARE YARD)[FOR SECOND COAT OF DILUTED ASPHALT EMULSION]		
	(Gallons)	
	0.10 gal ± 1% **	

The contractor shall determine actual field application rates by using the following formulas:

$$M = 0.10(b+a) + 0.3(c+b) + 0.10(d+c)$$

where-

M = Spread Modulus

a = 100% Passing Aggregate Size in Inches

b = 80% Passing Aggregate Size in Inches

c = 20% Passing Aggregate Size in Inches

d = 0% Passing Aggregate Size in Inches

After the spread modulus is determined the quantity of aggregate in pounds/square yard is determined using;

$$S = 0.80 (M)(W)$$

where-

S = Aggregate Spread in Pounds/Square Yard

M = Spread Modulus

W = Loose Unit Weight of Aggregate in Pounds/Cubic Foot

The quantity of asphalt emulsion in gallons/square yard is determined using;

$$A = 1.122(M)*(0.70)/R$$

where-

A = Asphalt Emulsion Spread in Gallons/Square Yard

M = Spread Modulus

R = Percent Residual Asphalt Content of the Emulsion

*The quantities of asphalt and aggregate shown in the table above are for bidding purposes only and were arrived at using the formulas above. The following values were substituted into the equations to arrive at these values;

a = 0.75 inch

b = 0.50 inch

c = 0.20 inch

d = 0.09 inch

W = 80.3 LB/Cubic Foot

R = 0.67 or 67% Residual Asphalt

****The asphalt emulsion used for the second coat shall be diluted a minimum of 50/50 with water or more as determined by trial.**

The contractor shall use the physical characteristics of the aggregate and asphalt emulsion proposed for use on the job to determine actual application rates.

10. PREPARATION OF SURFACE: Pavement patching and crack sealing as specified in SECTION: HMAC PAVEMENT REPAIRS and SECTION: JOINT AND CRACK SAWING, SEALING AND RESEALING IN PAVEMENTS shall have been completed for a minimum of 30 days to allow the patches to cure before beginning surface preparation for bituminous surface treatment. If installed on stabilized base or recycled areas, a prime coat shall be installed and allowed to cure. Prime coat installation shall be as specified in SECTION: BITUMINOUS PRIME COAT. Immediately before applying the first application of bituminous material, the surface shall be cleaned of loose material with power booms or power blowers. Care shall be taken to remove all dirt, clay, loose aggregate or other foreign matter.

11. APPLICATION OF BITUMINOUS SURFACE TREATMENT:

11.1 Bituminous surface treatment shall be applied in the areas indicated on the plans and as directed.

11.2 Application of Bituminous Material: If directed, bituminous prime coat shall be applied as specified in SECTION: BITUMINOUS PRIME COAT. Bituminous material on which the aggregate will be spread shall be applied by means of a bituminous distributor at a temperature within the range of 70 to 160 degrees F for SS-1 and CSS-1 and 125 to 185 degrees F for RS-2 and CRS-2, as directed. The bituminous material shall be applied in such a manner that uniform distribution is obtained over all surfaces treated. Building paper shall be spread on the surface for a sufficient distance back from the ends of each application so that flow through the sprays will operate at full force on the surface treated. Immediately after application, the building paper shall be removed and destroyed. Areas inaccessible to the distributor shall be properly treated with bituminous material using the hose attachment. Application of asphalt emulsion shall be exclusively cationic or exclusively anionic, the two types of emulsion shall not be mixed.

11.3 Spreading of Aggregate: Following application of bituminous material and just prior to the material "breaking", aggregate shall be spread uniformly over the surface within the limits of the quantities specified in paragraph QUANTITIES OF MATERIAL PER SQUARE YARD. Spreading shall be done with mechanical spreaders. Aggregate shall be spread evenly by hand on all areas missed by the mechanical spreader. Equipment spreading aggregate shall be operated so that bituminous material will be covered before any vehicle travels thereon. When hand spreading is employed on inaccessible areas, aggregate shall be spread directly from truck. Additional aggregate shall be spread by hand over areas having insufficient cover, and spreading shall continue during the operations when necessary.

12. **BROOMING AND ROLLING:** The surface shall be rolled with a pneumatic-tired roller after sufficient aggregate is spread. Rolling shall continue until no more aggregate can be worked into the treated surface. If the aggregate is not distributed properly, the surface shall be broomed as soon as possible after the first coverage by the roller, but not until the surface has set sufficiently to prevent excessive marking. Brooming, rolling, and supplemental spreading of aggregate shall continue until the surface is cured and rolled sufficiently to key and set the aggregate. In places not accessible to rollers, the aggregate shall be compacted with pneumatic tampers. Aggregate that becomes contaminated with foreign matter shall be removed, replaced with clean aggregate, and rerolled, as directed.

13. **SWEEPING:** After the surface has been satisfactorily rolled and cured, the surface shall be swept clean of all unadhered aggregate. The contractor shall exercise care while sweeping so as not to dislodge adhered or loosely adhered aggregate from the new bituminous surface treatment.

14. **FOG SEAL:** After non-adhered aggregate has been removed from the surface of the new bituminous surface treatment the contractor shall, if directed, apply a second or fog seal application of SS-1 or CSS-1 asphalt emulsion diluted with water. Rate of dilution shall be as directed and shall be as determined in the trial application. Application of second fog seal coat of asphalt emulsion shall be in accordance with paragraph 11.1 above. Fog seal application of SS-1 or CSS-1 shall be applied within the range of 70 to 160 degrees F. The contractor shall ensure that the fog seal coat of asphalt emulsion is applied without tracking or bare spots. The contractor shall use testing methods for application rate calibration described in paragraph 3.4 for calibration of the fog seal asphalt emulsion coat application.

SECTION 2K

ASPHALT PAVEMENT RECYCLING USING CLASS "C" FLY ASH

PART 1 - GENERAL

1. APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Military Standards (Mil. Std.):

MIL-STD-621A,	15 Jul 95, Notice 3, 22 Dec 64, Notice 1, 02 Jun 66, Notice 2, 06 Dec 68	Test Method for Pavement Subgrade, Subbase, and Base-Course Materials
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1.2 American Society for Testing and Materials (ASTM) Standards:

C 39-96	1996	Compressive Strength of Cylindrical Concrete Specimens
C 42-94	1994	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
C 617-94	1994	Capping Cylindrical Concrete Specimens
C 618 REV A-96	1996	Fly Ash and Raw of Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
D 977-91	1991	Emulsified Asphalt
D 1632-96	1996	Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory
D 1633-96	1996	Compressive Strength of Molded Soil-Cement Cylinders
D 2027-76	(R1992)	Cutback Asphalt (Medium

		Curing Type)Emulsified Asphalt
D 2028-76	(R 1992)	Cutback Asphalt (Rapid-Curing Type)
D 2922-91	1991	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017-88	(R 1993)	Moisture Content of Soil and Soil-Aggregate In Place By Nuclear Methods (Shallow Depth)

2. GENERAL: This section covers recycling of existing Hot-Mixed Asphalt Concrete (HMAC) pavements by pulverization and stabilization with Class "C" fly ash, complete.

3. DEGREE OF COMPACTION: Degree of compaction required is expressed as a percentage of the maximum dry density obtained by the test procedure presented in MIL-STD-621, Method 100, compaction effort designation CE 55. This will be abbreviated below as a percentage of laboratory maximum dry density.

4. PLANT, EQUIPMENT, MACHINES, AND TOOLS:

4.1 General Requirements: Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting the grade controls, degree and depth of pulverization, distribution of fly ash, control of moisture content and compaction as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specification.

4.2 Pulverization Equipment: Pulverization equipment shall be the Model 100R recycler, with water injection kit, as manufactured by the Bomag Company or approved equal. Salient features of this unit are as follows. Pulverization equipment shall be a self-propelled, pneumatic tired unit capable of pulverizing and blending asphalt pavement structure to a depth of 14 inches. Pulverization equipment shall have a mandrel equipped with carbide tipped "rock teeth" to pulverize asphalt pavement and underlying base course structures and blades to thoroughly blend the pulverized mass. The rotating mandrel shall operate in an up-cut mode to work the material up and over the pulverization teeth and blades within the drum. Pulverization equipment shall have the capability to inject water directly into the mixing drum in sufficient quantity to achieve the desired results.

4.3 Motor Grader: The motor grader shall be self-propelled, pneumatic tired unit capable of spreading, and shaping the pulverized mass to the proper lines and grades. The motor grader shall be capable of spreading the bulk dumped fly ash to the required depth uniformly across the pulverized pavement area to be recycled.

4.4 Compaction Equipment:

4.4.1 Sheepsfoot Roller: Sheepsfoot roller shall be either a self-propelled or mobile drawn unit equipped with vibratory capability. Sheepsfoot roller shall be a heavy steel drum equipped with nodules or feet around it's circumference and shall be capable of achieving initial compaction of the pulverized and stabilized mass.

4.4.2 Pneumatic-Tired Roller: The pneumatic-tired roller shall be either a self-propelled or mobile drawn unit. Pneumatic-tired roller shall be approximately 12 tons in weight with capacity to add ballast to suit conditions. Pneumatic-tired roller shall be capable of achieving final compaction of the pulverized and stabilized mass.

4.5 Water Truck: The water truck shall be a self-propelled, pneumatic tired unit. Water truck shall be equipped with hoses and pump and shall be capable of attaching directly to the mixing drum of the pulverizing unit and injecting water at the required rate into the drum. Water truck shall be capable of operating in "piggy back" fashion with the pulverization unit so as to ensure a constant supply of water to the mixing drum during mixing operations.

4.6 Bituminous Distributor: The distributor shall have pneumatic tires of such width and number that the load produced on the recycled surface does not exceed 650 pounds per inch of tire width. Distributors shall be designed and equipped to distribute bituminous material uniformly at even heat on various widths of surface, at readily determined and controlled rates ranging from 0.05 to 2.00 gallons per square yard, with a pressure range of 25 to 75 PSI. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gages, volume-measuring devices, a thermometer for reading the temperature of tank contents, and a hose attachment suitable for applying bituminous material to areas not accessible with distributor spray bar. The distributor shall be equipped for circulation and agitation of bituminous material during the heating process.

5. SUBMITTALS:

5.1 Materials proposed for use will be accepted on the basis of certified test reports from the material manufacturer indicating compliance with these specifications. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the materials, four (4) printed copies of these recommendations shall be furnished prior to use on the project. Submittals shall state the uncompacted, loose unit weight of fly ash materials. Work requiring manufacturer's recommendations shall not proceed until such recommendations are received and approved, and any work done prior to approval will be subject to rejection.

5.2 The contractor shall submit, for approval, a construction plan that identifies the proposed procedure to be used to control proportions of fly ash and water to be added to the pulverized mixture and the equipment and methods by which that equipment will be used to obtain the desired product.

6. DELIVERY AND STORAGE: Fly ash materials shall be delivered and stored in closed weatherproof bulk containers to prevent exposure to moisture. In no case shall fly ash be stored in contact with the ground, in pits or open containers.

7. SAMPLING AND TESTING:

7.1 Sampling and testing shall be performed by a Government approved commercial laboratory regularly engaged in such testing. Tests shall be performed in accordance with SECTION: CONTRACTOR QUALITY CONTROL and herein to ensure that material proportions and compaction meets the specified requirements. Four (4) copies of the test results shall be furnished to the Contracting Officer within 24 hours of completion of tests.

7.2 Samples of the pulverized material shall be taken directly to the testing lab for moisture/density/strength testing. Samples of the specified fly ash may be obtained from bag or bulk shipment, but fly ash obtained from different manufacturers shall not be mixed. Fly ash will be accepted on the basis of certified test reports and certificates of compliance from the fly ash manufacturer. The contractor shall submit certificates of compliance and certified test reports, for approval, to the Contracting Officer. No material shall be used on the job until certificates are approved by the Contracting Officer. The fly ash used for moisture/density/strength relationship shall be identical to that used in stabilization operations.

7.3 Mix Design: The contractor shall develop and submit for approval a proposed mix design prior to recycling work. Mix design shall be developed using samples of the pulverized material to be recycled and the fly ash to be provided. Mix design shall maximize strength for various contents of moisture and of fly ash combined with the pulverized material. Mix design shall determine the optimum moisture, maximum density and fly ash content for maximum strength of the recycled material. The mix design shall state the average maximum strength obtained. Mix design shall state the percentage, on a dry weight basis, of fly ash required to obtain maximum strength when blended with water and pulverized material. The mix design shall also state the % of water on a weight basis required to obtain maximum strength when added to fly ash, and blended with the pulverized material. The mix design shall also state the dry unit weight of the samples for field density purposes.

7.4 Laboratory Density: Laboratory density shall be determined in accordance with the test procedure presented in MIL-STD-621, method 100, compaction effort designation CE-55.

7.5 Unconfined Laboratory Compression Testing: Unconfined laboratory compression tests shall be conducted in accordance with ASTM D 1633. Samples for

strength testing shall be made in compliance with ASTM D 1632. Three tests shall be conducted for each mix design tested, and their average value shall be the maximum laboratory compressive strength. Samples shall be cured at a constant moisture content for 7 days prior to strength testing.

8. WEATHER LIMITATIONS: Addition of fly ash, final mixing, and compaction operations shall not be performed during freezing temperatures or conditions of rain. Any areas of completed course that are damaged by freezing, rainfall, or other weather shall be brought to a satisfactory condition in conformance with this specification without additional cost to the Government. Fly ash shall not be added to the pulverized mixture when the atmospheric temperature is less than 40 degrees F or is projected to fall below 40 degrees F during the mixing and compaction stages. Fly ash shall not be applied to soils that are frozen or contain frost, or when the underlying material is frozen.

9. WAYBILLS AND DELIVERY TICKETS: Since payment for the quantity of fly ash used in completion of the work will be made at the quantity negotiated and contained in each Task Order, submission of waybills and delivery tickets is not required.

10. ACCEPTABILITY OF WORK:

10.1 General: A lot shall be that quantity of construction that will be evaluated for compliance with specification requirements. A lot shall be equal to 5,000 square yards of recycled course produced. Testing shall be the responsibility of the contractor. Additional tests required to determine acceptability of nonconforming material will be the responsibility of the contractor.

10.1.1 Suitability of the recycled material will be based on the compressive strength of the in-place material compared to the compressive strength of the laboratory developed samples. For determination of in-place strength, the areas shall be divided into lots of 5,000 square yard area. The compressive strength for payment purposes will be the average of 4 sample cores taken within the lot. Cores for compressive strength tests shall be taken in accordance with ASTM C 42 and tested in accordance with ASTM C 39. Cores shall be capped prior to testing in accordance with ASTM C 617.

10.1.2 Alternative Testing Procedures: Alternative procedures for determining field compressive strength of the recycled structure may be used subject to the approval of the Contracting Officer. Examples of such alternative procedures are; Rebound Method using the Schmidt rebound hammer and, Penetration method using the powder actuated Windsor probe.

10.1.3 When a lot of material fails to meet the specification requirements, that lot shall be removed and replaced with graded-crushed-aggregate base course material or accepted at a reduced price, in accordance with the provisions of TABLE I. Percentage payment for compressive strength defined below shall be the percentage payment for

the area in that lot as well as the percentage payment for fly ash used in that lot. The percentage payment based on the compressive strength characteristics will be applied to the respective contract unit prices offered for Fly Ash and Asphalt Pavement Recycling and the resulting payment due the contractor determined.

10.1.4 The Contracting Officer reserves the right to sample and test any area that appears to deviate from the specification requirements. Testing in these areas will be in addition to the lot testing, and will be performed at the expense of the Government for testing that indicates satisfactory results. If testing indicates unsatisfactory results the contractor shall be responsible for the cost of testing and the cost of any subsequent testing required. The requirements for these areas will be the same as those for a lot.

10.1.5 All in-place compressive strength tests shall be completed and reported within 2 working days after construction of that lot. The contractor shall fill all sample holes with concrete or flowable fill, flush with the surrounding grade.

TABLE I. PERCENT PAYMENT BASED ON COMPRESSIVE STRENGTH	
% of Laboratory Compressive Strength Average (4 Cores)	Percent Payment
90.0-100.0 +	100.0
89.0-90.0	99.0
88.0-89.0	98.0
87.0-88.0	97.0
86.0-87.0	96.0
85.0-86.0	95.0
84.0-85.0	94.0
83.0-84.0	93.0
82.0-83.0	92.0
81.0-82.0	91.0
80.0-81.0	90.0
79.0-80.0	89.0
78.0-79.0	88.0
77.0-78.0	87.0
76.0-77.0	86.7
75.0-76.0	85.3
TABLE I. PERCENT PAYMENT BASED ON COMPRESSIVE STRENGTH (Continued)	
% of Laboratory Compressive Strength Average (4 Cores)	Percent Payment
74.0-75.0	84.0
73.0-74.0	83.0
72.0-73.0	82.0
71.0-72.0	81.0

70.0-71.0	80.0
69.0-70.0	79.0
68.0-69.0	78.0
67.0-68.0	77.0
66.0-67.0	76.0
65.0-66.0	75.0
below 65.0	Reject

11. MEASUREMENT:

11.1 Fly Ash: The quantity of fly ash to be paid for will be the negotiated number of 2,000 pound tons of fly ash for asphalt pavement recycling, and/or asphalt pavement repair, as stated in the Task Order.

11.2 Asphalt Pavement Recycling: The quantity of asphalt pavement recycling to be paid for will be the negotiated number of square yards of asphalt pavement recycling, by the method specified herein, as stated in the Task Order, regardless of the depth of pulverization.

12. BASIS FOR PAYMENT:

12.1 Fly Ash: Payment for the quantity of fly ash determined as specified above will be made at the contract unit price, per ton, as established in the bid schedule for Roadway work, or at a reduced price adjusted in accordance with paragraph ACCEPTABILITY OF WORK. Such payment shall constitute full compensation for labor, materials, testing, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

12.2 Asphalt Pavement Recycling: Payment for the quantity of asphalt pavement recycling determined as specified above will be made at the appropriate contract unit price per square yard, as established in the bid schedule for Airfield or Roadway work, or at a reduced price adjusted in accordance with paragraph ACCEPTABILITY OF WORK. Such payment shall constitute full compensation for labor, materials, bituminous curing membrane, testing, equipment, overhead, profit, supervision, and incidentals necessary to complete the work.

PART 2 - PRODUCTS

13. MATERIALS:

13.1 Fly Ash: Fly ash shall meet the requirements of ASTM C 618. Fly ash shall be Class "C" designation containing a minimum of 25 percent CaO. The source of the fly ash shall be identified and approved well in advance of the recycling operations so as not to delay testing and subsequent work.

13.2 Water: The water used in the stabilized mixture shall be clean, clear, free of sewage, vegetable matter, oil, acid, and alkali. Water will be furnished to the contractor from a designated base fire hydrant at no additional cost to the contractor.

13.3 Bituminous Material: Material shall conform to one of the following:

13.3.1 Cutback Asphalt: ASTM D 2027 or D 2028, Grade RC-250 or MC-250.

13.3.2 Emulsified Asphalt: ASTM D 977, Type RS-1 or RS-2.

PART 3 - EXECUTION

14. GENERAL: In preparation for installation of subsequent HMAC or bituminous surface treatment wearing courses, the contractor shall be required to construct a completed section of recycled asphalt pavement that contains a thoroughly pulverized and homogenous mixture of existing asphalt wearing course and base structure, water, and self-cementing fly ash materials. The recycled section shall contain no loose or segregated areas, shall have a uniform density and moisture content, shall be of proper grade and thickness, and shall be well bound through its entire depth. However, any surveying requiring payment under SECTION: SURVEYING, shall be approved prior to accomplishment.

15. PULVERIZATION: Pulverization of the existing asphalt pavement structure shall be accomplished with the equipment specified to thoroughly pulverize and blend the asphalt wearing course and underlying base course materials into a homogenous mixture. Pulverization shall be accomplished to a depth required to pulverize and blend the entire asphalt surface and base materials without incorporating subgrade materials into the mixture or the maximum depth imposed by the design limitations of the specified pulverization equipment that ever is deepest. The contractor shall adjust the depth of pulverization such that no subgrade materials are included in the mixture. Should subgrade materials begin to appear in the mixture, the depth of pulverization shall be reduced until the subgrade materials disappear. The contractor shall put forth every effort to ensure that subgrade materials are not incorporated into the recycled section. Pulverization shall be accomplished to a degree necessary to completely pulverize and blend the materials. Pulverization shall be accomplished and continued until, in the opinion of the Project Engineer, pulverization is complete.

15.1 Initial Pulverization: Prior to pulverization for the entire job, the contractor shall thoroughly pulverize a small area identified by the Government to obtain pulverized materials required to complete laboratory testing for development of the mix design. Initial pulverization shall be conducted, using the pulverization equipment specified, at no additional cost to the Government. After the initial pulverization is completed, and the required samples extracted, the pulverized area shall be graded and compacted to sustain traffic during the testing period. Supplementing the area with graded-crushed-aggregate base course material in accordance with SECTION: GRADED-CRUSHED-AGGREGATE BASE COURSE, will be acceptable to bring the pulverized area up to surrounding grade, or may be directed to increase the thickness of the pulverized section.

15.2 Intermediate Pulverization: After the proper proportions of fly ash and water for the recycled section have been determined in the laboratory, intermediate

pulverization may begin. Intermediate pulverization shall be accomplished one lane at a time with traffic permitted on the adjacent lane(s) unless otherwise approved. Intermediate pulverization shall be accomplished to prepare the roadway for final pulverization, application of fly ash and mixing. Intermediate pulverization shall also be accomplished to determine the depth of pulverization and required tonnage of fly ash required to complete the recycling operation. As intermediate pulverization is accomplished, the material shall be shaped with the specified motor grader and compacted with pneumatic tired rollers to permit traffic to use the pulverized surface until the fly ash is deposited on the surface.

15.3 Final Pulverization: Just prior to the application of the specified fly ash, the pulverized material shall be repulverized and shaped to the proper grade. Excess material shall be removed such that after the fly ash is incorporated and the section compacted, the surface will meet the specified grade. Final pulverization shall be accomplished with the roadway closed, and application of fly ash shall be accomplished IMMEDIATELY after final pulverization is completed.

16. DISTRIBUTION OF FLY ASH:

16.1 The roadway shall be closed to vehicular traffic during the distribution of fly ash material. The manner in which fly ash is distributed is critical to maintain the proper amount of ash in the recycled mix. The ash shall be transported to the site in pneumatic tankers capable of bottom dumping in a windrow down the center of the roadway surface. Just prior to dumping, the ash shall be "fluffed" by blowing compressed air. After the ash has been dumped, it shall be distributed evenly, at the required thickness, across the entire roadway. IMMEDIATELY after the distribution of the ash, mixing of the ash, water, and the pulverized material shall begin.

16.2 Stationing shall be established at 50 foot intervals along the length of roadway to be recycled to aid in the proper distribution of the fly ash materials. Stakes shall be set at 50 foot centers, similar to "blue topping" to ensure the proper thickness of fly ash is distributed over the entire area to be stabilized. Thickness of the fly ash layer will be predetermined by the Project Engineer and will be based on the depth of pulverization and the recommended ash content as determined by laboratory testing.

To minimize movement of the ash materials after they are deposited, flags should be set and the truck driver instructed where to dump the ash on the roadway. Lateral movement of the ash across the roadway is easily accomplished by blading, while longitudinal movement down the roadway is almost impossible to accomplish by any method. Therefore, uniform distribution of each load over the prescribed distance is critical to maintain the required ash content.

17. CONTROL OF MOISTURE CONTENT:

17.1 Control of moisture in the materials to be recycled presents the most difficult and critical aspects of the recycling process. The optimum moisture content for maximum compressive strength, as determined by laboratory testing, is the target

moisture content to be maintained during recycling operations. Typically, optimum moisture content for maximum compressive strength will be at or slightly below the optimum moisture content for maximum density. The difference between the two depends upon the amount and type of fly ash, the material being recycled, and the delay in final compaction of the mixture. Strengths of the recycled materials decrease significantly as moisture content increases above optimum for maximum compressive strength. Strengths also decrease when the moisture content is on the dry side of optimum for strength and increased compactive effort is required to achieve proper compaction at the lower moisture contents. Care shall be exercised to maintain the moisture content at the stated optimum during the mixing operation. Moisture content shall be checked using the procedure outlined in ASTM D 3017 to ensure the proper moisture content.

17.2 Control of the moisture content is complicated by the fact that a significant quantity of water must be added to bring the moisture content of the mixture to the required level after final pulverization. Addition of the mix water after fly ash materials have been blended with the recycled materials increases the delay in mixing, final compaction and the resulting strength of the material and will not be permitted. Adding sufficient water to the pulverized material prior to distribution of the fly ash also can create problems. Generally, moisture content of the pulverized material must be raised 8 to 14 percent above optimum for density without fly ash added, so that following addition of the fly ash, the moisture content of the combined mixture will be at the desired level. The pulverized material containing this much water is generally unstable and makes it difficult to operate the bulk trucks and spreading equipment on its surface. Consequently, the contractor may incorporate some water into the mixing drum of the pulverization equipment during the final pulverization operation to bring the moisture content toward optimum for strength and reduce the amount of water required during mixing, or may incorporate all the water required in the final mixing process. However, all the required water shall not be added during the final pulverization process. Aeration and additional pulverization may be required after the final pulverization to achieve the proper initial moisture content prior to dumping of the fly ash on the roadway surface.

17.3 Maximum control of moisture content is possible by the introduction of the required water directly into the mixing drum of the pulverizer. This method is specified and shall not be deviated from. Application of water to the fly ash distributed on the roadway surface will not be permitted, neither will incorporation of water after the fly ash has been mixed. The water injection system, including the water truck shall be thoroughly checked out and calibrated well in advance of the requirement for the equipment. The water content of the materials shall be monitored during construction through the use of a nuclear density gauge. Moisture readings obtained from the nuclear gauge will be somewhat in error when tests are conducted on materials in a loose state. The error factor will be relatively consistent and a correction factor shall be established by comparing the moisture contents before, during and after compaction by the use of a test section prior to adding the fly ash. The use of the nuclear moisture

gauge is invaluable when used as a tool for controlling moisture content during the course of the work.

17.4 The manner in which moisture content will be controlled shall be carefully considered prior to construction. Weather can greatly affect the moisture content of the materials and the resulting methods of moisture control. The contractor shall be required to present, in writing, the method(s) that will be used to control moisture content in the pulverized mixture prior to application of the fly ash materials and the procedure(s) that will be used for introduction of water during the application of fly ash materials. Procedures shall clearly show the methods to be followed, including number and distribution of nuclear moisture content tests.

18. COMPACTION OPERATIONS:

18.1 Compaction of the recycled base/asphalt/fly ash/water mixture shall begin IMMEDIATELY after the fly ash and water have been thoroughly mixed and incorporated into the pulverized base/asphalt material. The sequence of construction events and the concern of all contractor personnel shall be directed toward achieving compaction of the material before the fly ash hydrates. Hydration of the fly ash begins immediately upon exposure to water. Cementitious bonds formed after the material hydrates will be broken if densification occurs after hydration and the bonds will not reform. A significant loss in strength will result if densification is delayed. The compaction equipment shall follow IMMEDIATELY behind the pulverization/mixing equipment to ensure that initial densification is accomplished in a timely manner. Final compaction shall be accomplished as soon as possible, but shall be completed within TWO HOURS after incorporation of water and fly ash into the pulverized mixture.

18.2 Initial Compaction: Initial compaction shall be accomplished by the use of a vibratory "sheepsfoot" roller. The sheepsfoot configuration provides good compaction throughout the entire depth of the layer from the bottom to the top. The vibratory action will contribute considerably to the compactive effort. Even though final compaction is delayed for up to two hours, if initial compaction is accomplished with the sheepsfoot vibratory roller, the resulting strength of the compacted mixture will not suffer significantly.

18.3 Final Compaction: Following initial compaction of the recycled section, the roadway shall be shaped to the required grades by blading with the specified motor grader. Excess material shall be cut away and disposed of as required to maintain the proper grade for the intended surface course thickness to follow. Final compaction shall be accomplished with the specified pneumatic tired roller. Steel wheel rollers shall not be used. The pneumatic tired roller shall be applied judiciously to the area to be compacted for a time not to exceed TWO HOURS after the initial compaction is complete.

19. CURING: IMMEDIATELY after the final compaction of the recycled pavement section has been completed, the surface shall be protected against rapid drying for 7 days by the application of bituminous material sealcoat. Bituminous

material shall be uniformly applied by means of a bituminous distributor within the temperature range recommended by the material manufacturer. Bituminous material shall be applied in quantities of not less than 0.1 gallon per square yard nor more than 0.25 gallon per square yard. Areas inaccessible to or missed by the distributor shall be properly treated using the manually operated hose attachment. At the time the bituminous material is applied, the surface of the area shall be free of loose or foreign matter and shall contain sufficient moisture to prevent excessive penetration of the bituminous material. When necessary, the area shall be sprinkled immediately before the bituminous material is applied. Treated surface shall be sanded or dusted to prevent the bituminous material from being picked up by traffic if required by the Contracting Officer.

20. FIELD QUALITY CONTROL:

20.1 General Requirements: The contractor shall perform the inspection and tests described herein and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

20.2 Results: Results of field quality control testing shall verify that materials comply with this specification. When a material source is changed, the new material shall be tested for compliance. When deficiencies are found, the initial analysis shall be repeated and the material already placed shall be retested to determine the extent of unacceptable material. All in-place unacceptable material shall be replaced or repaired, as directed by the Contracting Officer, at no additional cost to the Government.

20.3 Thickness Control: Completed thicknesses of the recycled course shall be within 1/2 inch of the thickness specified. Thickness of the stabilized course shall be measured, if directed by the Contracting Officer, at intervals in such a manner as to ensure one measurement for each 5,000 square yards of recycled course. Measurements shall be made in 3-inch diameter test holes penetrating the stabilized course. Test holes shall be repaired by filling with flowable fill or concrete.

20.4 Testing: Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory regularly engaged in such testing. Field in-place density shall be determined in accordance with ASTM D 2922. ASTM D 2922 will result in a wet unit weight of recycled mixture. When using this method ASTM D 3017 shall be used to determine the moisture content of the recycled mixture. The calibration curves furnished with the moisture gages shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gages shall be made at the beginning of a job on each different type of material encountered and in intervals as directed by the Contracting Officer. Moisture content tests shall be conducted at intervals sufficient to determine the moisture content of the pulverized mixture, as determined by the Contracting

Officer, prior to the addition of fly ash. Government personnel will be on site during this operation to evaluate tests results to determine compliance with the specification. Fly ash shall not be added until the pulverized mixture has sufficient moisture content that the additional required water can be added during the mixing by the water injection method only. Moisture content and density tests shall be conducted continuously during the fly ash/water mixing and densification process. Government personnel will be on site during this operation to evaluate tests results to determine compliance with the specification. Should test results indicate deficiency density within the 2 hour period after the addition of fly ash additional compactive effort shall be applied to bring the material up to the required density. Within 24 hours of conclusion of physical tests, 4 copies of test results, including calibration curves and results of calibration tests, shall be furnished to the Contracting Officer. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests.

20.4.1 Optimum Moisture and Laboratory Maximum Density: Tests shall be made from the samples of pulverized material obtained prior the start of initial pulverization. These tests will be used as representative of the remainder of the material.

20.4.2 Laboratory Compressive Strength: Tests shall be made from the samples of pulverized material obtained prior the start of initial pulverization. This sample will be used as representative of the remainder of the material.

20.5 Smoothness Test: The surface of the recycled layer shall show no deviations in excess of 3/8 inch when tested with the 10-foot straightedge. Deviations exceeding this amount shall be corrected for high areas by blading excess material and removing it from the surface, and for low areas by making up the difference in actual and plan grade with HMAC at no additional cost to the Government. Measurements for deviation from grade and cross section shown shall be taken in successive positions parallel to the road centerline with a 10-foot straightedge. Measurements shall also be taken perpendicular to the road centerline at 50-foot intervals.

21. TRAFFIC: Traffic, except that required for construction of the subsequent surface course layer, will not be permitted on the recycled course. No traffic of any kind will be permitted on the area until after the bituminous material has cured.

22. MAINTENANCE: Recycled area shall be maintained in a satisfactory condition until the surface course is placed.

23. DISPOSAL OF EXCESS MATERIALS: Removed materials required to meet grade shall be disposed of off the confines of Government property at no additional cost to the Government.

24. PLACEMENT OF SURFACE COURSE: IMMEDIATELY after the bituminous curing material has been applied and the compressive strength test results indicate acceptable material, the HMAC or bituminous surface treatment surface course shall be placed.

SECTION 2L

PAVEMENT MARKINGS

PART 1 - GENERAL

1. **APPLICABLE PUBLICATIONS:** The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 American Society for Testing and Materials (ASTM) Publications:

D 638-95	1995	Tensile Properties of Plastics
D 4061-94	1994	Retroreflectance of Horizontal Coatings
E 303-93	1993	Measuring Surface Frictional Properties Using the British Pendulum Tester Apparatus
E 308-96	1996	Standard Practice for Computing the Colors of Objects by Using the CIE System
E 1349	1990	Reflectance Factor and Color by Spectrophotometry Using Bidirection Geometry

1.2 Federal Specification (Fed Spec):

TT-B-1325C	9 May 95, 1 Jun 93	Beads (Glass Spheres) Retroreflective
TT-P-1952D	7 Jan 94	Paint, Traffic and Airfield Marking, Waterborne

2. SCOPE:

2.1 This section covers the application of painted and preformed pavement markings to Portland cement concrete and asphalt cement concrete airfield, street parking lot pavements and other similar paved areas, complete.

2.1.1 Permanent preformed pavement marking tapes will be required only on new pavements constructed in conjunction with paving task orders and will require layout. Temporary preformed markings may be required on existing pavements and will require layout and later removal.

2.1.2 Painted pavement markings may be required on existing or new roadways, parking lots or airfield pavements. New markings on new pavements or new markings on existing pavements without markings will require layout. New markings over existing markings will not require layout.

2.2 Description of Work:

2.2.1 Base Airfield Markings: Painted markings on airfield pavements shall consist of yellow and white reflective and non-reflective edge lines, center lines, touchdown, threshold, fixed distance, overrun chevrons, and runway designation numerals and letters. In addition, symbols such as compass calibration points and instrument checkpoints may also be required. Painted airfield pavement markings shall be provided where shown on drawings provided and where directed by the Contracting Officer.

2.2.2 Base Street and Parking Lot Markings: Painted markings on street, parking lot and other similar pavements shall consist of 4 inch wide reflective white and reflective yellow centerlines, lane delineators gore lines, edge lines, parking space lines, and other miscellaneous markings. Painted legends, symbols, turn arrows, and words will not be required. Permanent preformed markings on street and parking lot pavements shall consist of 4 inch wide reflective white and reflective yellow centerlines, lane delineators, gore lines, edge lines, parking space lines and other miscellaneous markings. Preformed legends, symbols, turn arrows, and works will also be required. Painted and preformed street and parking lot pavement markings shall be provided where shown on drawings and where directed by the Contracting Officer.

2.2.3 Temporary Pavement Markings: At times, it may be necessary to install temporary pavement markings on Roadway pavements to control the flow of traffic or for other purposes as deemed necessary by the Government. These markings will be of the preformed variety and because of their nature, layout will be required. Temporary markings will be limited to the installation and removal of 4 inch wide white or yellow centerlines, lane delineators, edge lines, parking space lines and other similar markings. Temporary legends, symbols, turn arrows or words will not be required.

3. EQUIPMENT: All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition.

3.1 Paint Applicator: The equipment for applying the paint binder may be self-propelled, mobile drawn or propelled by hand and shall be a pneumatic spraying machine with an arrangement of atomizing nozzles capable of applying in a single pass a line 6 inches in width. The machine shall be capable of applying the paint at the rates specified in paragraph 4 at an even and uniform thickness, with clear cut edges. The paint applicator shall have a paint reservoir or tank of sufficient capacity to apply paint as prescribed by the requirements of this specification. The spray mechanism shall be operated by means of quick opening and closing valves conveniently located and shall include necessary pressure regulators and gages in full view and reach of the operator

at all times. Paint strainers shall be installed in the paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns.

3.2 Reflective Media Dispenser: The dispenser for drop-on of the reflective media shall be attached to the paint dispenser and operate automatically and simultaneously with the paint applicator through the same control mechanism. The dispenser shall be designed to provide uniform flow of reflective media at the established rate of coverage as indicated above regardless of the speed of the paint applicator to which it is attached.

3.3 Preformed Marking Application Equipment: Mechanical application equipment shall be used for the placement of preformed pavement markings. Mechanical application equipment shall be defined as a mobile pavement marking machine specifically designed for use in applying precoated, pressure-sensitive pavement markings of varying widths, up to 12 inches. The inlay method, where the preformed marking is rolled into the freshly laid paving mixture using a steel wheeled roller is the specified application method. Should circumstances preclude the use of the inlay method, the contractor shall follow the manufacturer's installation instructions. As a minimum, the applicator used shall be equipped with rollers, or other suitable compactive device, to provide initial adhesion of the preformed, pressure-sensitive markings with the pavement surface. Additional hand-operated rollers shall be used as required to properly seat the preformed markings. Adhesives or glues shall also be used as applicable and as recommended by the manufacturer to achieve the desired results.

3.4 Sweeping Equipment: Sweeping equipment shall be equipped with rotary sweeping brushes to dislodge dirt from the pavement surface and a vacuum attachment to pick up the dirt and store it in the sweeping machine. Sweeping equipment shall be of the proper size and capacity as required for cleaning surfaces to receive markings.

4. SUBMITTALS: Materials proposed for use will be accepted on the basis of certified test reports from the material manufacturer indicating compliance with these specifications. Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the materials, four (4) printed copies of these recommendations shall be furnished prior to use on the project. Work requiring manufacturer's recommendations shall not proceed until such recommendations are received and approved, and any work done prior to approval will be subject to rejection.

5. DELIVERY AND STORAGE: All materials shall be delivered and stored in the manufacturer's sealed shipping containers and stored in the manner and at the temperature recommended by the manufacturer.

6. SAMPLING AND TESTING: